

The American Midland Naturalist

Devoted to Natural History

Primarily that of the Prairie States

Founded by J. A. Nieuwland, C.S.C.

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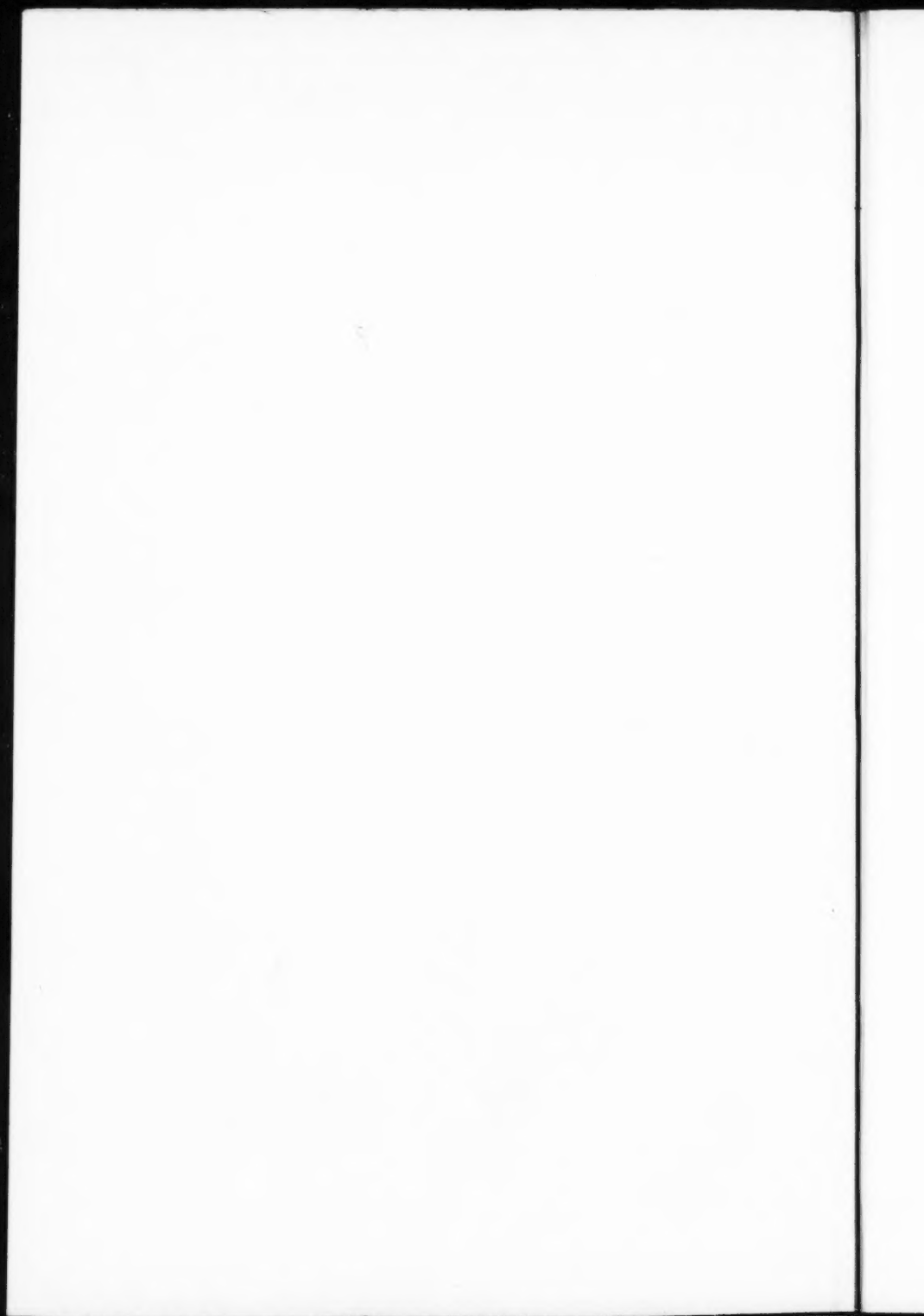
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No. 1

Environmental Responses of Vertebrates in the Great Basin*

Jean M. Linsdale

Introduction

Naturalists have studied the Great Basin area in the Western United States less extensively than other more readily accessible regions in the country. But, other considerations were more important than accessibility in taking me to this region for field studies. The survey reported on here was concerned less with the usual type of faunal analysis than with the problems of responses of the animals to their surroundings, including other organisms. I wanted to see, at first hand, examples of the environmental responses of individuals of vertebrates which live in the high desert mountain ranges of the Great Basin.

A point may be raised as to the reason for going to a remote locality to study processes which take place wherever vertebrates occur. The explanation lies in the circumstance that in the high desert ranges of the central Great Basin many of the conditions which seem to affect these animals are present apparently in extreme form. It was anticipated that more examples of environmental control of vertebrates could be observed in a given time in such severe surroundings than in a more equable region. Here, more species and individuals probably are living near their limits of toleration as regards one or more of their environmental influents than in many other regions in the United States.

Factors which influence the distribution of vertebrates must be of the same kinds which affect the daily routine of behavior of the individuals. If an animal is enabled by its structure (including the equipment involved in its sensory behavior) to cope with its surroundings and survive, it is likely to be able to live wherever similar surroundings exist. Species doubtless tend to extend their ranges until they reach places where the individuals can no longer accommodate themselves to the environmental conditions. This does not imply necessarily that the same kind of factor is responsible for range delimitation everywhere along the border of an animal's range. It does seem obvious, though, that the factors which delimit ranges of species must be of the same kinds as determine local habitats.

* Contribution from the Museum of Vertebrate Zoology, University of California.

If the line of reasoning suggested above is valid, then one profitable means of learning the nature of the factors effective in habitat restriction and range delimitation is to study the behavior of individuals and to pay attention to details of responses of the animals to their surroundings. Useful facts to be sought are examples of individual actions which show some connection with the environment. The observations must concern wild animals in their natural surroundings.

A major cause for confusion in attempts to analyze the environmental relations of birds may be the failure to distinguish between internal and external factors concerned in these relations. It may be impossible to separate completely these two kinds of influences and to evaluate them in the whole question of habitat behavior. But the problem would be simplified if consistent effort were made to learn the reasons for restriction in habitats by studying both the organism and its objective surroundings. It must be remembered that every individual reacts to a given set of surroundings in its own peculiar way and that the reactions of members of a species resemble one another in manner comparable to the resemblance of external features of structure. Hence it is practicable to combine items dealing with members of a single species, but not of distantly related ones.

As regards internal factors, it may be better to formulate a series of reasonable assumptions, for purposes of field analysis, than to engage in practically endless tests (measurements) of physiological and psychological activity. For example, we may accept it as demonstrated that birds have remarkably well developed powers of vision, without being able to determine with exactness many qualities of those powers. Many details have been discovered in connection with the units concerned in the physiological behavior of certain types of birds. These furnish clues as to what we may expect to learn of the physiology of other birds and of the possible relations between physiological condition, behavior, and the external environment.

Physiography

The Toyabe Mountains in central Nevada constitute an independent and isolated range except at the south end where a series of cross ridges connects them with the Shoshone Mountains, a parallel range to the west. The trend of the range is northeast to southwest, between 116 degrees and 118 degrees W, mostly along 117 degrees W. It is cut midway by the 39th parallel of latitude. In general outline the range appears to be a single high ridge but there is really a double system of ridges with interior longitudinal basins. (See Figs. 1 and 2.)

Beginning at the northern end where the range is lowest, the ridges rise gradually until they culminate on the east at Bunker Hill, 11,735 feet and on the west at Big Creek Peak, 10,265 feet. The greater part of the eastern ridge, which is about 1000 feet above the western one, drains into Smoky Valley on the east through Park Creek, Birch Creek, and Kingston Creek which break through the ridge. Big Creek flows to the west into Reese River Valley. Reese River parallels the range and drains the cross ridges at the

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VERTEBRATES IN THE GREAT BASIN

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southern end. South of Kingston Creek which is south and west of Bunker Hill, there is only one ridge. The main ridge, with its steep eastern slope and more gentle western one, rises gradually toward the south until it reaches Arc Dome, the highest peak of the range.

Detailed items regarding the physiography of the Toyabe region are

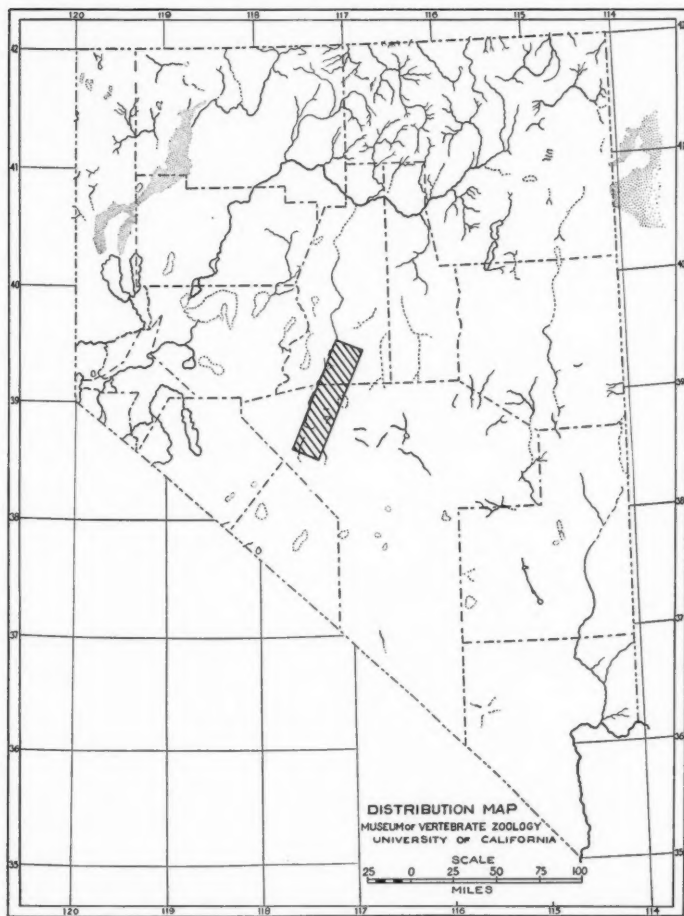


Fig. 1. Map of Nevada showing location of the Toyabe Mountains area (rectangle) near center of the state.

given in the section of this report dealing with the habitat. These minor features appear to be intimately connected with the local occurrence of the vertebrates.

The Habitat

It seems to me that in view of our relatively meager knowledge of faunal natural history in the Great Basin portion of western United States the most logical procedure in such a survey is to pay most attention to the species as units in the whole fauna. For this reason, in the field observations and the written report I have emphasized the species. Secondary emphasis has been placed upon analysis of the environment and for this purpose divisions of the habitat have been recognized as indicated in the following classification.

Aquatic	Woodland
Standing water	Aspen
Rain pool	Willow
Playa	Birch
Pond	Mountain mahogany
Running water	Piñon
Spring	Limber pine
Cañon stream	Rockland
Low vegetation	Talus
Marsh	Cliff
Meadow	Human-made
Desert	Building
Brushland	Road
Buffalo berry	Mine shaft
Sage brush	Cultivated field

Aquatic habitats in the Toyabe area are insignificant as far as their total area is concerned. Their importance is that they attract a few individuals of numerous species which otherwise would not be represented in the region at all. Also they affect some of the strictly land birds indirectly by their influence upon the immediately adjacent vegetation.

Except for a few very small lakes in the mountains the standing water is on the floors of the main valleys. There are some places where small pools collect and the water remains for a few days after rains. These pools in spring supply breeding places for toads and spadefoot toads and they attract small groups of transient shore birds which feed and rest there.

Water bodies of a slightly different type occur or have occurred in Smoky Valley. Only a few years back a good-sized playa lake occupied the center of Smoky Valley. The recent series of dry years, however, has resulted in this bed being dry most of the time. A smaller basin, about 3 mi. SE Rogers Ranch, is in about the same stage. During one or two seasons since this work began there was water in these basins. They served as feeding and resting places for a few kinds of ducks and wading birds. The main source of water for these playa lakes is the overflow from streams from the mountains.

A storage reservoir for irrigation water in the lower course of Peavine Creek is located out in Smoky Valley southeast of the Toyabe Mountains.

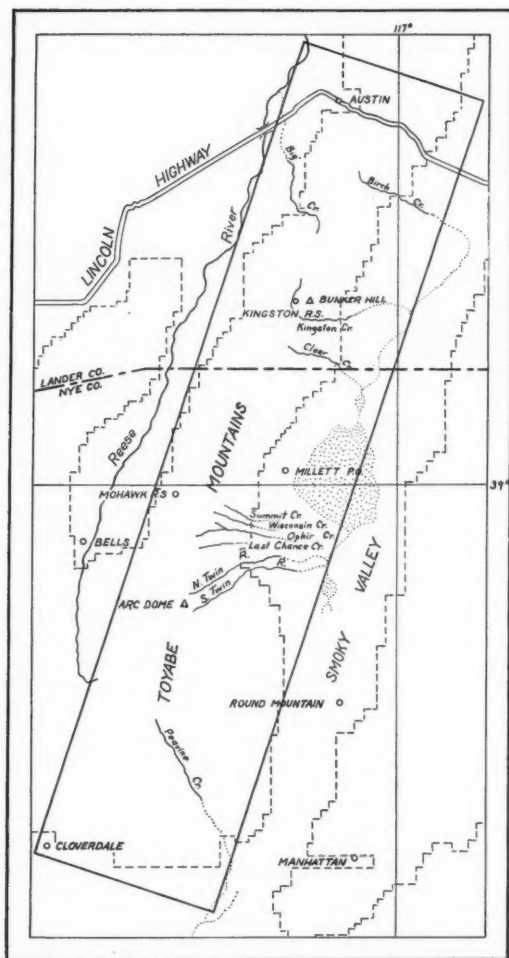


Fig. 2. Map of Toyabe Mountains area showing locations of places mentioned in this report and relation of the area studied (rectangle) to the mountain range and the valleys. Scale, about 14 miles to the inch.

It too is dry part of the time, and like the playa lakes it supports no extensive growth of aquatic vegetation. Hence the attractions offered to birds are so meager that only small numbers can be expected. However, if there ever is sufficient moisture in this area to keep these basins filled for a time sufficient



Fig. 3. Part of a large spring in Smoky Valley. Overflow from this spring maintained a long strip of wet marshland. The brush fence built to keep stock out of the deep waterhole provided screen and cover for vertebrates. Small fish in them attracted fish-eating birds. Photographed on June 3, 1930.

to establish marshes, a large population of water birds doubtless would result.

Around the margin of the basin of the largest of the playa lakes in Smoky Valley there is a series of springs varying from small water-filled holes only a few inches across to large open pools many feet in diameter (Fig. 3). The ponds resulting from these springs are fairly permanent and most of them contain an abundance of vegetation as well as a considerable amount of animal life. They are inhabited by more kinds of water birds than any other kind of aquatic habitat within the area. The birds attracted are mainly ducks, herons, and the coot.

In the mountains the surface water is mainly in the small streams which start at high seeps or springs and rush down the mountain sides. Sometimes they pour down among the rocks after running a short distance; sometimes they extend as far as the base of the mountains, but usually no farther. Water from the larger streams is spread over fields near the mouths of the cañons for irrigation.

The direct influence of these streams upon vertebrates is to attract such animals as the toad, dipper, navigator shrew, and jumping mouse (Fig. 4).

On the west side of the mountains is the largest stream in the area, Reese

River, which drains the high southern part of the range and runs northward toward the Humboldt River. In it live many muskrats, besides the animals common to aquatic habitats elsewhere in the area.

Some of the springs mentioned above are really marshes. Others overflow to form small, narrow marshes filled with cattails or bulrushes. The largest of these is scarcely more than 100 yards long. Kinds of birds whose presence is dependent upon this habitat are the marsh wren, marsh hawk, yellow-throat, red-winged and yellow-headed blackbirds, sora, Virginia rail, yellow rail, and bittern. For these birds these small marshes offer concealment, feeding places, and nest supports. The meadow mouse is the most numerous of the mammals here. (See Fig. 5.)

Meadows in the Toyabe area were of two sorts. Mountain meadows such as those on Birch and Kingston creeks were small and far apart (Fig. 6). They were flooded in spring and early summer, but at least in some years dried out sufficiently for a person to walk over them by midsummer. The abundant moisture, vegetation, and insect food on these meadows in summer combined to make them concentration points for a good many kinds of vertebrates. However, their altitude and the conditions accompanying it limited the kinds that could survive there. The level of most of these meadows was between 7000 and 8000 feet, and this meant freezing temperatures and even snow late into the summer.

The other kind of meadow in the area was found in the two main valleys, Reese River at 6500 feet and Smoky at 5500 feet. The former had more extensive meadow lands but the latter was studied more intensively. When we began work near the large meadow (500 acres approx.) 6 mi. SE Millet



Fig. 4. Birch Creek near the upper end of the gorge and just below Birch Creek Meadows. Dippers were seen flying along the streams here. This is one of the large streams of the range. Photographed on June 25, 1930.

on April 20, 1930, it was practically bare, the whitish alkali soil showing over most of it. Plants were just beginning to show above the surface. The most conspicuous feature of the meadow at that time was the numerous, exceptionally large, gopher mounds. Most of them were old, but there were some



Fig. 5. Marshy area occupied by a nesting colony of Brewer blackbirds in Smoky Valley. Other birds which nested here were mallard and Savannah sparrow. Photographed on June 6, 1933.

recent ones. A few kangaroo rat burrows were seen. Both these kinds of mammals were trapped. The most numerous bird at that time was the horned lark on the barer parts. There were Savannah sparrows in the taller grass and meadowlarks around the margins.

After three weeks of wet weather the plants on this meadow were up sufficient to give a green appearance, but the cover was still thin, the growth being very slow. Iris made up a large proportion of the plants in the moister part of the meadow.

The whole Toyabe area is characteristically a desert (Fig. 7), but the rigorous conditions are moderated somewhat by the high altitude. The extreme of desert conditions here is found in the beds of the dried up playa lakes. The combination of heat or cold, dryness, and high alkaline content of the soil has resulted in almost complete absence of plant growth and of vertebrate animals.

Buffalo berry was found to be the predominant plant in a belt $\frac{1}{2}$ to 2 miles wide around the alkali flat southeast of Millett in Smoky Valley. The plants grew as isolated bushes or as parts of dense thickets averaging ten

feet in height and running up to 15 feet. This bush also grew at other places in the region, especially in the neighborhood of streams on their lower courses.

When we began work in this vicinity on April 20, 1930, most of the clumps were just coming into leaf and they were dropping the petals of small yellowish flowers. The leaves are small but they cover the branches densely. The branches are remarkably brittle. They are covered with large thorns which are heavy and sharp and which effectually bar progress through a thicket. The dead branches drop to the ground, if broken, or remain in place and add themselves to the thorny barrier.

Thickets varied in size up to 50 or 100 yards across. In some places vines of rose had grown through the bushes and these added to the denseness of the tangle. Between the clumps and around the bases there were scattered mounds of bunch grass. The bushes grew right up to the margins of some of the spring pools and mingled with the willows. Limbs from this plant had been cut and arranged to form barriers around most of the deeper springs in the vicinity to prevent stock from miring in the mud.

Sage brush was the most frequent and most thoroughly characteristic plant in the Toyabe area (Fig. 8). From Smoky Valley where there were many patches, this shrub covered the sides of the mountains to the highest ridges. Sometimes it grew in pure stands and sometimes mixed with trees or other kinds of bushes, but everywhere it grew it formed an important feature in the habitat for vertebrates. This plant was one of the most persistently uniform elements in the environment. The low, stocky form and the arrangement by clumps with intervening bare ground were features that made this



Fig. 6. Meadow on Kingston Creek. Meadows in the mountains were more uniform than ones in the main valleys. The summer season was distinctly shorter here. Fewer birds inhabited them than ones at lower levels. The numerous clumps of willows were the main attractive features to birds in this meadow. Photographed on June 15, 1930.

and other desert bushes favored living quarters of many kinds of animals.

Among the important items necessary for vertebrate existence and furnished by sage bushes are the following. Shelter from the wind and from pursuing predators is everywhere available in the sage bushes but more espe-



Fig. 7. Desert at base of mountains looking northeast toward North Twin River, South Twin River on the right. In 1930 mammal trapping was more productive, both as to species and individuals, on this area than any other place studied in the region. Photographed on May 12, 1930.

cially those patches in the less exposed places such as the cañons of the streams. Also shelter from the sun is provided for a great many kinds of animals by the sage bushes. At the same time perching places are offered within and on the tops of the bushes which are desirable because of their exposure to some degree of sunlight and to open surroundings. Birds use such perches as lookouts both for flying insect food and for objects on the ground. Nesting sites in the sturdy crotches of sage bushes are suited to the needs of many kinds of small birds. Accumulations of trash around the bases of the bushes make suitable places for openings of small burrows that mammals and reptiles commonly occupy. Although not especially desirable as a food source for vertebrates several kinds were recorded as depending largely upon the leaves and bark for nutriment. This use is most prominent in the winter when deep snow covers other kinds of food possibly more desirable. In many places the best material available for nest building is that supplied in the shreds of bark and stems from sage bushes.

Rabbit brush occurs as a conspicuous shrub through the belt of buffalo berry, and it grows in a nearly pure stand in a belt between the buffalo berry and sage brush. In some places this belt is several hundred yards wide. Here the plants grew mostly in large clumps. At the base of each was an accumu-

lation of trash—dead stems and leaves—which provided screen and possibly food for small mammals. There was some grass close to each clump.

Jack rabbits were numerous in this habitat. Also, in late April 1930, many specimens of *Peromyscus maniculatus* and of harvest mouse were trapped. But after several weeks of rain there seemed to be a great reduction in numbers of these small rodents. Our trapping indicated that not more than one tenth as many were present as had been there at first. When the alkaline soil was wet it made a sticky mixture which dried slowly. It seemed as if it would be difficult for small mammals to go through this mud when it was wet. Possibly most of the large numbers of mice which we caught during our first visit there had moved in from some drier habitat. For birds these bushes provided temporary perching places but little else.

Aspens grew in two types of places in the Toyabe Mountains: one, along the main streams from 8000 to 9000 feet and especially along the larger side cañons just above the main growth of birches, and, the other, about moist places on protected, usually north-facing slopes, along with or just below limber pines.

As examples of the first type, in the north fork of Wisconsin Creek there were only a few small patches each composed of 25 to 50 trees. The south fork of Wisconsin Creek had a flat floor 25 to 50 yards wide that was almost completely covered with aspens of large size. Here the trees grew 3 to 6 feet apart with tall straight trunks. Practically all of the ground was shaded and covered with a nearly unbroken leaf litter. In 1930 the leaves on the trees did not come out until the second and third weeks of May. Before that the trees had practically no birds except stragglers from other kinds of plants.



Fig. 8. Sage brush on a slope close to Birch Creek Meadow. A colony of Brewer blackbirds nested in the taller bushes on the lower part of this slope. Photographed on June 25, 1930.

As soon as the leaves began to unfold there was a marked increase in the number of birds, chiefly transients and summer residents which foraged through the foliage. Satisfactory nesting positions among the branches were few and were mainly such as were used by magpies and warbling vireos. In



Fig. 9. Meadow on Kingston Creek, 7500 feet. Several kinds of birds, including both the fox sparrow and the song sparrow, nested in the willow clumps. Photographed on June 15, 1930.

holes in the trunks nests of flickers, hairy woodpeckers, and chickadees were seen. Cassin purple finches were noted among aspens.

The patches of aspens on north-facing slopes, especially in the northern part of the mountains varied considerably in the size of the trees. Often whole patches were broken and flattened by the snow and wind in the winter. They then made dense tangles.

Willows predominate on the lower courses of the streams in the Toyabe area, chiefly outside the cañon mouths. They occurred chiefly as dense thickets of small stemmed, slender individuals 9 to 15 feet high, which grew in a narrow border close to the stream. Also high in the mountains willows in clumps furnished hiding, foraging, and nesting places for birds (Fig. 9). A third type of growth was found on a north-facing slope near the head of a creek. Here there was a uniform stand of plants 6 to 10 feet high which covered 2 or 3 acres of wet ground.

In the cañons from 6500 to 7500 feet both willows and birch were present but the stand of the latter was much larger, and it nearly filled the flat area next to the water. This tree grew in clumps of 20 to 50 stems, each with a diameter up to 15 or 20 cm. and usually about 30 feet high. Ordinarily the clumps intertwined, and the dead and living stems made a tangle hard for a person to get through. The stems were both vertical and leaning, sometimes,

even, horizontal. The foliage was fine and the leafage dense. It thus made good nest supports for bush-tits and warbling vireos. Robins nested in the larger crotches. About the base of each clump were accumulated twigs and leaves and green sprouts which formed a screen and support for Nevada towhee and fox sparrow nests. The leaf litter on the ground beneath the canopy was heavy.

On the slopes of the mountains especially on the eastern side we found mountain mahogany to be the principal tree from around 7500 feet up to 9500 feet (Fig. 10). The stand was not uniform, but the trees were in groups ranging in size up to 15 or 20 acres but usually smaller. These patches were found most often on the sides of ridges where there was some protection from the wind. At the lower altitudes piñons were scattered among these trees and throughout the belt, wherever the trees were not close together, the chief shrub was sage. At a few places, mainly near Kingston R. S., we saw stands where the trees were close enough together to shade practically all the ground. In places the branches intertwined so that dense thickets were formed. Beneath these heavy growths there was usually a good ground cover of leaf litter, but few small plants were seen beneath the canopy.

The trees averaged about 18 feet in height. Often several trunks came from one base. Sometimes there was only one large trunk, and this was nearly always under a foot in diameter. Some of the older trees had hollows (natural), and others had been bored into by flickers. The branches of mountain mahoganies provided nest supports for nearly all the tree nesting



Fig. 10. Mahogany Cañon, the floor of which was covered with mountain mahogany trees. The hermit thrush was a characteristic bird in this west-facing, dry valley. Photographed on July 2, 1931.

birds at these altitudes. The foliage was heavy and many birds foraged through it, most of them, however, not extensively.

The piñon-juniper belt characteristic of the mountains in the Great Basin was represented in the Toyabe area mainly by piñons (Fig. 11). Over most



Fig. 11. Wisconsin Creek, looking upstream from 7800 feet. The ridge in the distance is the main divide of the range. Here the stream is small and it has had little influence upon the vegetation or animal life. Many jumping mice were trapped in this vicinity. Photographed on May 31, 1930.

of the range junipers were scarce and usually they were small ones. Most of the piñons, too, were small. They occurred mainly between 6500 and 8000 feet. Over much of this area these trees were spaced 10 to 50 yards apart with tall sage between them. At some places, usually on steep slopes, they were close enough together to shade about half the ground surface. In these places they covered the rocky soil with needle-litter and crowded out the ground vegetation. On many slopes $1/3$ to $1/2$ the trees were mountain mahoganies.

Average height of the piñons was 15 to 20 feet. Average thickness of the trunk just above the base was 6 to 10 inches. The branches began at the ground, but they were short and tended to reach upward, thus giving the trees a slim appearance where they were close together.

The best growths of limber pine on the Toyabe Mountains were between 9500 and 10,500 feet on the steep, wet, northwest-facing slopes of peaks. According to local testimony practically all the patches of limber pine were logged in the days of mining activity. A fairly typical stand of second-growth

limber pine was examined on June 14, 1930, at 10,000 feet on the ridge south of Kingston Creek.

The trees there were small, being mostly 4 to 8 inches in trunk diameter. A few were as large as 20 inches in diameter. In height they varied from 25 to 30 feet. From any one place within the grove I could see for 30 to 50 yards in each direction through the trees. More than half the ground was shaded. Logs of trees that had been blown over were frequent, between 20 and 30 being in sight. In this grove the ground was rather dry. On the surface were small rocks mixed with the leaf mold. There were a few small gooseberry bushes, some freshly broken branches of pine and a few small snowbanks.

Many of the side branches of the trees were short and as a rule they pointed upward at a sharp angle. Many of the standing trunks were dead and some had holes drilled into them. In some patches the trees were considerably larger than in this one, and in these the trees were farther apart. Also in most of them the ground was covered with snow which remained late in the summer.

Rockland made up a conspicuous part of the Toyabe area. In most places, however, the influence of the rocks was secondary to that of the plants in determining the nature of the vertebrate inhabitants of the ground. Conspicuous exceptions were found in the talus-covered slopes and at the steep cliffs.

Slides composed almost purely of rock of various sizes covered many of the slopes in the mountains. These at higher levels supplied homes for a few vertebrates, mainly pikas and marmots. Toward the base of the mountains the collared lizards were characteristic rock-dwelling animals, and every-



Fig. 12. A large rock outcrop, adjacent to Birch Creek Meadows, where a long list of cliff-dwelling birds nested. The meadow contributed an abundant food supply which supported extra large numbers of birds here. Photographed on June 25, 1930.

where in these rocks could be found rock wrens. Varying degrees of warmth and dryness appeared to be the variable factors which directly and indirectly were mainly responsible for the differing types of use of this type of habitat by the vertebrates which lived in it at different levels. The contrast with similar appearing rock slides in the Sierra Nevada with respect to amount of moisture was paralleled by the sparseness of the vertebrate fauna among the rocks in the Toyabes.

The high, nearly vertical faces of cliffs in the Toyabe Mountains constitute a conspicuous feature of the landscape, and they exerted important influences upon the vertebrate fauna of the area. Chief among these was the safety provided for homes, particularly for nesting sites of birds. Where located close to favorable feeding areas a small extent of cliff could accommodate large numbers of nesters. An especially favored example was the huge outcrop at the upper end of the meadows on Birch Creek (Fig. 12).

Buildings within the Toyabe area were so few in number that they could exert little influence upon the whole population of vertebrate animals. The buildings were mainly residences and simple, small ranch buildings. Approximately half of them were no longer occupied by their former human inhabitants, and thus the native animals had undisturbed, free access to them. A few species made use of such structures for shelter from the weather, and several others, mainly birds in the nesting season, made the buildings their homes for the breeding season. In this group were the big-eared bat, bushy-tailed and desert wood rats, Say phoebe, barn and cliff swallows, and English sparrow.

Roadways covered only an insignificant part of the whole area, and they affected the birds and mammals only slightly. Bridges where the Lincoln Highway crossed the Reese River attracted nesting cliff and barn swallows and Say phoebes.

The deserted mine shafts scattered throughout the mountains were almost invariably inhabited by wood rats. Say phoebes nested at sites within the entrances of these diggings. Although we expected to see bats in the tunnels, search in several of them failed to reveal the presence of any of the animals.

Cultivated fields in the area were small in number and in total extent and in Smoky Valley apparently were restricted to alfalfa and a few patches of rye. The latter were usually planted early in May. In many seasons late freezes checked the growth of alfalfa. In some fields the stand was not good; the many bare places helped to make a better forage ground for birds than would have been a thick stand. At least many of the species found there would, I am sure, have been absent if the plants had been tall and close together. For most of the fields there was an abundant supply of water for irrigation, and this helped to increase the insect life and, in turn, the bird life. Several kinds of birds lived in the alfalfa fields. Others foraged into the fields from the creeks and adjacent sage patches. The posts of the fences around the fields provided perches that were used as resting places and as lookouts for food hunting.

Inspection of several fields indicated that aside from a few gophers

(deterred by irrigation) and jack rabbits, this habitat was not especially suited to the small mammals of this region. Few sign of their presence could be detected. Evidently most of the mammals there were adapted for a more uniform and drier type of place for existence.

Factors concerned in Environmental Relations of Birds

The following outline is intended to be an indicator of the attitude of the observers in gathering the information contained in this report rather than a final evaluation of all the factors concerned in environmental relations of birds. It represents, to some extent, my present notions as to the kinds of factors concerned in these relations and the nature of their contributions to the biotic complex. It suggests also the types of material sought in the field work and the direction in which effort was made in the course of observing. Some such guide as this is necessary in the undertaking of any faunal survey if the results are to be more than a mass of unrelated items. The fact that the outline is incomplete and inadequate gives further emphasis to the desirability for its use. It has been the aim throughout this whole project to learn facts which show the true significance of the following factors:

Internal

- Genetic history of the race, and even the individual, insofar as this determines
- Sensory responses to stimuli involving
 - Vision
 - Audition
 - Orientation
- Hormonal rhythms and responses of
 - Pituitary
 - Gonads
 - Thyroid
- Behavior patterns involved in nervous system

External

- Physical
 - Topography
 - Climate
 - Weather
 - heat
 - cold
 - rain
 - snow
 - Light
 - Vegetation
 - Water
- Biotic
 - Food
 - Competition
 - Other kinds
 - Same kind

Materials and Acknowledgments

The objectives and plan of procedure adopted in this work were similar to those which guided earlier faunal surveys in which I have had some part. In general, the main objective was to study the relations of vertebrates to their environment and especially to gather facts that would show as nearly as possible what species of land vertebrates were present within the area; the frequency of occurrence and the relative abundance of those species; the local habitat distribution of each species; the factors which determine the presence and habitat distribution; the annual cycle of activity of each species in the area; a way to analyze vertebrate associations and successions.

Severe physical conditions in this region, which markedly restrict the numbers and activities of people, also affect in high degree the vertebrate animal life. As a result we may anticipate a scarcity of individuals of most kinds

of animals, but sufficient numbers to occupy all the time and energies of an observer or, even, of a whole corps of observers.

In any general faunal survey, such as the present undertaking, it is necessary, if loss of much effort is to be avoided, to select for attention only a few of the many problems encountered. Obvious hindrances soon appear, no matter what scope of analysis is planned. Close attention to a single species or to one small phase of the life of a species results in much valuable information concerning that kind of animal, but it fails to show the relative position of that species with respect to the whole biota. In somewhat similar manner, it seems that attending wholly to broad problems of animal distribution, sociology, or numbers fails to give adequate insight into faunal problems of any sizable geographic area.

When Miss Annie M. Alexander visited the Toyabe Mountains in central Nevada, with Miss Louise Kellogg in the spring of 1925 and again during the winter of 1926-1927, she was so impressed by the opportunities for detailed faunal studies in the rugged and little-known area that she planned for a more extensive survey of the vertebrate animals there and an analysis of their environmental relationships. I was fortunate in being given the opportunity to undertake this survey as a part of the general program of the California Museum of Vertebrate Zoology. My first visit to the area was made in the summer of 1930. Short trips were made in each of the three succeeding summers.

I am thankful to Miss Alexander who made preliminary surveys in this territory and then maintained an interest in my work there to the present stage, and to Dr. Joseph Grinnell for help throughout the work in the field and the preparation of the report.

During the early seasons spent in the field in the Toyabe area, I was accompanied by Mr. Chester C. Lamb of the Museum staff who was active and persistent in the effort to collect series of specimens. On other trips, when emphasis was placed on observation, other workers volunteered to go. I am especially grateful to Mr. Lawrence V. Compton, who in addition to collecting and taking notes was relied upon for most of the photographs obtained. Dr. Alden H. Miller and Mr. Robert T. Orr likewise were generous in recording observations of the type desired in this survey.

Several persons resident within the area were helpful in making my work easier. Among these may be mentioned especially Ranger A. R. Torgerson and Mr. Will J. Farrington and their families.

Dr. Harry C. Oberholser of the United States Biological Survey generously allowed me to examine and use records of that Bureau, which apply to this part of Nevada. These included not only his own made in 1898, with Vernon Bailey, but materials gathered by the following persons: Vernon Bailey (1890), Luther J. Goldman (1915), and Ernest G. Holt (1916).

A large part of the time in the field in the Toyabe survey was spent in collecting specimens. Approximately 2500 vertebrates were preserved, including 750 amphibians and reptiles, 1050 birds, and 700 mammals. All of these

are in the Museum of Vertebrate Zoology. About 1000 specimens of plants were collected. Photographs numbered about 225.

Three hundred and twenty-one field-days were spent in the area, between 1930 and 1933, by the 5 persons who worked there, as follows: Linsdale, 167; Lamb, 81; Compton, 35; Orr, 26; Miller, 12. The tabulation given below shows the locations of camps established in this area and the distribution of each observer's field-days.

Big Creek

Linsdale—June 23-24, 1931; 2
Linsdale—August 14-15, 1932; 2

Mohawk R. S.

Linsdale—June 17-21, 1931; 5

Birch Creek

Lamb—June 21-24, 1930; 4
Lamb—August 29-September 3, 1931; 6
Linsdale—June 21-24, 1930; 4
Linsdale—June 25-27, 1931; 3
Linsdale—August 29-September 3, 1931; 6
Miller—June 21, 1930; 1

Kingston Creek

Lamb—June 4-20, 1930; 17
Lamb—September 4-7, 1931; 4
Linsdale—June 4-20, 1930; 17
Linsdale—June 28-July 3, 1931; 6
Linsdale—September 4-7, 1931; 4
Linsdale—August 16-17, 1932; 2
Miller—June 10-20, 1930; 11

Millett P. O.

Linsdale—July 4-6, 1931; 3

Millett P. O., 5 miles southeast

Compton—May 18-June 7, June 10-18, 1933; 30
Lamb—April 20-28, May 13-20, June 2-3, 25, 1930; 20
Lamb—September 8-11, 1931; 4
Linsdale—April 20-28, May 13-20, June 2-3, 25, 1930; 20
Linsdale—September 8-11, 1931; 4
Linsdale—May 14-31, June 6-8, August 18-19, 1932; 23
Linsdale—May 18-June 7, June 10-18, 1933; 30
Orr—May 14-31, June 6-8, 1932; 21

Wisconsin Creek

Lamb—May 21-June 1, 1930; 12
Linsdale—May 21-June 1, 1930; 12
Linsdale—June 1-5, 1932; 5
Orr—June 1-5, 1932; 5

North Twin River

Compton—June 19-21, 1933; 3
Linsdale—June 19-21, 1933; 3

South Twin River

Compton—June 8-9, 1933; 2
Lamb—April 29-May 12, 1930; 14
Linsdale—April 29-May 12, 1930; 14
Linsdale—June 8-9, 1933; 2

Amphibians

Scaphiopus hammondi Baird

Spadefoot toads in the Toyabe region were distinctly animals of the desert. Except one, observations on this toad were made on the floor of Smoky Valley, 5 mi. SE Millett. Here a favorable set of circumstances produced larger numbers of this species than are ordinarily found, and opportunity was afforded to observe many items in the life cycle.

The earliest record, seasonally, for this toad in Smoky Valley is of an adult caught during the night of April 23, 1930, in a mouse trap set among the sand dunes which border the alkali flat near Millett. Rain fell during most of that night, beginning at 8:30 p.m. The rain gauge at Millett, less than 4 miles away, showed .20 of an inch of precipitation for the 24 hours. This was the first rain after the first day of the month, when .03 of an inch was recorded. On May 14 and 16, calls of spadefoots were heard in this vicinity, but the exact location of the animals was not determined. The species was again noted here when a single individual was found on the evening of June 26, on the ground close to a permanent pool.

On May 14, 1932, the first night after my arrival with Orr, in this vicinity, the toads were heard calling just after dark. Four individuals were found in the shallow water at the margin of a small pond. Three of the toads showed the tops of their heads above the water and the fourth was at the bottom, completely submerged. After these four were taken no more calls were heard until after we had returned to camp at 8:30 p.m., when they began again in the same direction. On the evening of May 16, five individuals were caught at the margin of this pond. Two were on the mud and the others in the water. The pale gray ground color of all but one of the individuals indicated that they had just arrived at the pond. When kept overnight in water they turned dark, mostly with a greenish ground color. A single toad, taken from this pond on the evening of May 17, was the last one found there.

No search for eggs or larvae was made at this pond, but on May 24 many large gray tadpoles of this species were noted there as well as smaller ones of *Bufo boreas*. One of the spadefoot tadpoles was watched feeding at the surface film of this pool on May 30. It supported the body vertically with the rapidly moving tail and worked its mouth at the surface. At intervals of about 1 minute it dropped below the surface, but soon returned.

It may be worth mentioning that although there are several dozen small ponds and springs in the neighborhood of the one just mentioned, some of them permanent and others present in early summer only, no spadefoot toad was found in any of the others.

Northeastward from this camp is a large alkali flat which, only a few years ago, was the site of a lake in the center of the valley. Within a mile to the east and south broad pasture-meadows contain the following conspicuous plants: *Iris missouriensis*, *Sisyrinchium halophilum*, *Potentilla anserina*, *Dodecatheon pauciflorum*, and sedges and grasses. In years of heavy snow-fall when there is a surplus of water in North Twin and South Twin

rivers, in the Toyabe Mountains, a little work with a scraper and a plow will result in flooding this whole field of more than 500 acres. Briefly, this is what happened in the summer of 1932, when there was considerably more water than in either of the 2 preceding years. By May 14, when I arrived in the neighborhood, the water had just started to run under the fence at the upper end of the large field. Within 4 days it had reached the lower margin of the field and was running out onto the bare flat. When I left on June 9 the water was spread in a sheet over practically the whole pasture, and over most of it there was sufficient slope to produce a perceptible current.

The response of spadefoot toads to the situation just outlined is interesting because it differs markedly from conditions where the species is generally found. At dark on May 15 a chorus of toads was heard to the southward from the camp. We found the animals near the upper edge of the pasture, nearly a mile way. Many individuals were scattered over the pasture in the shallow, running water, but we were able during a short search to find only one. It was difficult, even when 2 persons approached from different directions, to determine the exact location of any particular individual. In our walk along a road across the sandy desert back to camp we picked up 4 more toads. Again we verified the observation that the ones on the dry ground were pale gray in color. Also we noted that the reflection of the eye by flashlight was pink, and that the pupil was dilated to a circular outline. One toad had dug in so that only its eyes showed above ground.

On May 16 the water reached the part of the pasture directly east of the camp, and that night the toads were heard in that direction for the first time. The calls toward the south seemed to be less numerous and to indicate a smaller number of animals than had been heard the previous day. In the evening of May 18 the toads were heard northeast of the camp at the lower (northern) edge of the big pasture. Thus, each night, the calls came from farther down the stream. At least 1 individual was heard at 4 o'clock in the afternoon, nearly 2 hours before sunset, when the sun was shining with a clear sky. A few were heard the same morning at 6:45 a.m., long after sunrise. At 5 o'clock on the evening of May 22, toads were heard in the pasture eastward from the camp. After dark the air was cold and still, and a louder chorus than ever was heard from the lower part of the meadow. None was heard in any other direction, even from places where they had been heard in abundance, early the previous week. On the last night of our stay, June 8, the air was warm, and the chorus of spadefoots from the flooded pasture seemed as loud as ever.

From accounts of spadefoots that I have read I judged that the toads came out of their burrows only after rain, and that a certain amount of moisture was necessary to bring them to the surface. However, the fact that so many hundreds of individuals came out of the ground in Smoky Valley in 1932, when no rain had fallen for a long time, indicates that other circumstances are able to initiate activity in this species. In the case of toads that were buried in the pasture when it was flooded, it seems logical to suppose that the soaking of the ground supplied the stimulus for emergence. But in the case of those individuals that were found out on the desert and up to

half a mile from the nearest water, it is hard to think of the water as having any effect on the time of leaving their burrows. The sounds made by the toads already in the water may have been the means of bringing others out of the dry soil. Even this would not explain the emergence of those animals, especially the first ones, which gathered at the small pool northwest of the camp.

Another problem is concerned with the apparent movement of the animals across the pasture at the time it was flooded. When the water had reached just the upper end of the area, toads were heard there only. On each succeeding night they were farther along until, after the whole field was flooded, they were heard only from its lower part. It might be that with the progressive flooding of new ground a new lot of toads came out each night and then withdrew to burrows within a few days. Or the toads, which I would not expect to be adapted for holding a position in moving water, may have been carried along with the current until almost all were congregated at the lower edge of the area. This second explanation seems the more reasonable to me.

No search was made for eggs or small larvae, but when crossing the flooded pasture on May 30 and 31, we noticed thousands of large tadpoles swimming and feeding, mostly in the shallow margins of pools, near the edge of the field. At one place many dead tadpoles were scattered on the bottom of a pool. Live ones were feeding at the carcasses of these. Several others were seen feeding at the surface film of water. They seemed to be fairly active in spite of the fact that the water was decidedly cold. However, during the day when the sun was shining, the water became hot.

Most of the tadpoles must have come from eggs laid several miles up the current, for at the rate they were drifting they would have covered a great distance in a week, even if allowance is made for their being detained in pools. Apparently they did not often attempt to go against the current; nearly all were carried with it. There appeared to be few, if any predators in the pasture that might eat the tadpoles; 6 black-crowned night herons were seen, but it was not certain that they fed upon amphibians. However, one peculiar sort of danger confronted these tadpoles. This pasture had been inhabited by a large number of pocket gophers. When the water came, it poured down into the burrows of these animals and swept down with it any tadpole which came near. One was watched as it was carried down into a burrow in spite of its struggles to swim against the current. The water here was strongly alkaline and appeared reddish brown, especially where it stood for a time.

The cool weather of the last week of May and the first week of June may have prolonged the growing period for the tadpoles, but at the same time it saved the water by decreasing the evaporation. A sufficient quantity of water was thus assured to allow for completion of transformation of a large proportion of the toads.

On May 20 an overnight visit was made to a reservoir 7 mi. N or San Antonio, also in Smoky Valley. Many spadefoot toads were heard in the evening, mostly out among the numerous clumps of bushes in the water and 20 to 50 feet from the shore. The animals were hard to see; 2 out of 3 were picked up on the shore and the third was out in the water.

Later in the summer, on August 19, another trip was made to Smoky Valley, and several hours in the morning were spent at the large pasture SE Millett. Here between 7:00 and 10:00 a.m. hundreds of small, recently transformed spadefoot toads were found. In the summer all the water on the surface had dried up, but the soil was still moist. The cover of plants had helped in preserving the moisture, and on that particular morning the leaves were still wet at 10 o'clock. Most of the toads were seen in patches of silver-weed (*Potentilla anserina*) which formed a dense mat near the ground.

Early in the morning most of the toads were active on the surface, but later many of them retreated into shallow excavations, sometimes completely covered with earth. Each of these shallow burrows extended downward at approximately 45° from the horizontal. Judging from the number of vacant holes, the toads evidently had been coming out each night for some time to feed, and then had dug in again at a new place as the air warmed and became drier each morning. Evidently they take advantage of the opportunity, whatever time of year it comes, to feed. The long periods when the toads are underground must result from necessity induced by unfavorable conditions and not from any particular choice for living in burrows.

In 1933, with Compton, I worked in this same vicinity from mid-May to mid-June. The pasture was fairly dry this time, but a large proportion of the 1932 brood of spadefoots had survived, and we saw them almost daily. We were surprised to see them day after day foraging on the surface of the ground in daylight hours. Although most of the individuals were seen in early morning or late afternoon, a few were seen at mid-day on clear, hot days—that is, with temperatures between 95 and 100 degrees.

Usually, however, by 8 a.m. most of the toads still in sight were engaged in various stages of burrowing. They took advantage of any depression or crevice they found, such as occurred beneath clods, in the edges of horse hoofprints, or in the burrow of some other animal. When a toad dug beneath the surface, the loose soil completely covered it; no open burrows were seen.

Size varied widely in these animals; the largest ones found measured 32 mm. in head-body length. We concluded that all the individuals we saw in 1933 were members of the 1932 brood.

Finally, in review, the 2 items of most interest to me in this series are (1) the emergence of breeding adults independently of rainfall and (2) the extensive foraging of the young ones in daylight hours.

Bufo boreas boreas Baird and Girard

Toads occurred at widely scattered places in the Toyabe region from the lowest valleys up the mountains at least to 7500 feet. The chief requirement, to determine local presence of this species in the valley, seemed to be the presence of surface water in amount sufficient for carrying through the life history to transformation. In the mountains, cold at high altitudes may have acted to limit activity of the toad through restriction of moisture, or in other ways.

Toads were noted several times in Smoky Valley, 5 mi. SE Millett. On May 14, 1932, one was seen after dark submerged in the shallow water 4 feet from the shore of a small pond where spadefoot toads were calling. This one was silent; the lower surfaces of its thighs were blackish. Small tadpoles of this species were found here on May 24. On May 30 this pond was drying up rapidly, and many tadpoles were stranded on mud at the margin or in hoofprints where the water would soon be gone.

In this vicinity, on May 19, 1932, in a small pool about 6 by 10 feet across and only a few inches deep close to an extensive marshy area there were a great many, estimated at 600, small black tadpoles of this toad. At 4 p.m., although the water was cool, the tadpoles were very active, moving rapidly through the water and appearing to feed along the straws and sticks. When at 7 a.m. on May 22 I visited the pool, there had been little evaporation, and it was larger than when first found. The tadpoles, concentrated on the bottom near the southern margin, appeared to be feeding. They were only slightly active at this time. After dark on May 23, when the air was cold, the tadpoles were grouped in 3 or 4 dense clusters in the shallow water on the south side of the pool. By May 26 the tadpoles had grown considerably. They were then widely scattered and feeding in the warm water. This was their status also on May 28. On May 29, the water was cold again, and the tadpoles had clustered together into a dense aggregation in the shallow water of the southern part of the pool. Scattered dead ones on the bottom appeared to be covered with mold.

At the pond in Smoky Valley where yellow-headed blackbirds nested, on May 19, 1932, about 6 toads were heard calling after dark. The 10 or 12 clear and soft separate notes were uttered rapidly. The high pitched notes reminded me of notes of the Cooper hawk. A toad was calling at this pond in the midmorning of May 20, 1933, and another on June 10. On the latter date one was seen on top of floating dead stalks of cattail within a patch of new growth of that plant. At another pond in this vicinity, on June 17, 1933, a half grown individual was seen in the water.

On August 19, 1932, a lot of 363 newly transformed toads were picked up just at dark in the small residual pool, only a few inches across, that remained in the bed of the reservoir 7 mi. N San Antonio. The animals apparently had transformed just in time to escape from the last traces of moisture in what, earlier in the summer, had been an abundant supply. A small individual, less than half grown was picked up in the road $1\frac{1}{2}$ mi. S Darrrough's in the morning of August 20, 1932.

Along Reese River, on June 9, 1932, a toad was heard shortly after 1 p.m. in a pool south of the Lincoln Highway.

In the mountains this species was recorded as follows: Big Creek Camp Ground, June 23, 1931; Birch Creek, 7000 feet, June 24, 1930; Kingston R. S., 7500 feet, June 10 to 15, 1930, and August 16, 1932; Kingston Creek, 6500 and 6000 feet, June 16, 1930 and September 4, 1931; South Twin River, 6500 feet, June 5, 1933.

Rana aurora draytonii Baird and Girard

Red-legged frogs are not native anywhere in Nevada, but in the springs close to Millett we saw individuals on numerous occasions from 1930 to 1933. Members of the Farrington family which lived at the ranch there told us that according to tradition one of the early settlers Mr. Gendron who lived a few mi. N Millett in Smoky Valley had brought in individuals of this frog from California and had liberated them in the springs about his place. The frogs were known locally as "French Frogs."

Specimens were obtained, July 4 and 6, 1931, in the large spring at the roadside at the Farrington ranch. They resembled individuals from California except for more brilliant red coloring on the underparts.

Reptiles

Crotaphytus collaris baileyi (Stejneger)

The collared lizard proved to be one of the most narrowly restricted of the lizards found by us in the Toyabe region. The kind of surroundings inhabited made up only a small part of the whole area. The habitat was recognized as ground conspicuously covered with medium- or large-sized rocks. All individuals observed were living on this rocky ground and in the belt on the lower slopes of the mountains between 6500 and 7500 feet.

Earliest record, seasonally, is of a specimen obtained at noon on May 12, 1930, on a rock at the tumbled-down foundation of an old cabin near South Twin River, 6500 feet. On May 27, 1932, 2 more were obtained near this stream at 6500 feet and 7000 feet, both on rock slides. Near by on North Twin River, at 6500 feet, 4 individuals were shot on May 27, 1932. In mid-morning one was found clinging to a small rock, 8 inches in diameter. Another was found on top of a small rock in a roadway near a large pile of rocks. Two were on the tops of dark brown rocks in piles below the mouth of the cañon. In midafternoon of July 6, 1931, a young one was shot on a rock beside the trail in the bottom of this cañon. On May 31, 1930, a collared lizard was obtained from a rock in a slide at 7500 feet on the north side of Wisconsin Creek.

Crotaphytus wislizenii Baird and Girard

The leopard lizard was found at many localities in Smoky Valley and around the margin up to about 6500 feet. There was little uniformity in type of soil inhabited; sometimes it was on hard alkali ground, sometimes on fine sand, and sometimes on rather coarse gravel. At all these places scattered bushes or clumps of bushes provided shelter as well as feeding places for the insect prey of the lizards. Kind of bush made little difference so far as our work indicated preferences.

When a leopard lizard was disturbed it usually ran to the base of a nearby bush or down some old mammal-made hole. Once when the wind was blowing especially hard, it was noticed that certain individuals permitted closer approach than was the rule in quiet weather. On June 1, 1933, about 25 leopard lizards were seen in the lower end of a field and the adjacent desert

close to South Twin River, 6000 feet. They were seen mainly running from one bush to another when disturbed. One that started to run on nearly bare ground was followed and driven in a circle where there was nothing to hide beneath and no hole to enter. After going not much more than 100 yards, it apparently had become so tired out that it could scarcely move, and it was easily picked up. Since I had followed it in a walk, it is possible that something was wrong with the animal.

A hunting leopard lizard was watched on May 23, 1932, on the desert about 6 mi. S Millett. At first it ran to a large grasshopper fluttering at the base of a bush. The lizard held the tip of its tail high in the air. After a successful escape, the grasshopper flew off, about 2 feet above the ground, and the lizard followed, running swiftly and directly beneath the insect.

A mating pair of leopard lizards was seen on June 1, 1933. One individual held the skin on the middle of the back between the shoulders of the other firmly in its jaws and clasped it at the flanks firmly by the forelegs. The animals separated when disturbed by my close approach.

Another segment of pre-mating behavior was watched on June 5, 1933. About noon, when the pair was seen first, the male was grasping the skin of the female by the back between the shoulders. The animals moved, together, for about 50 feet to the margin of a thorny bush. After a minute or so the female crawled into this bush, just off the ground, and remained there, scarcely moving, for over an hour. It was still there when I left at 1 p.m. The male kept its hold, several times making quick forward moves or jerks. After 15 minutes it released its hold and bit at the skin of the female along the back and on the head. Then with mouth opened widely it bit at the side of the head of its mate. Next it moved away completely but returned, and, beginning on the back at the base of the tail, moved forward to the head, biting, rubbing its jaws over the skin, and appearing to attempt to turn over the female which was much larger, nearly twice the size of the male. The latter seemed unable to move the larger animal which, although it remained motionless, seemed actually to welcome the manipulations. The male left this location and returned 3 times during the hour.

Two or three out of about 20 individuals seen on June 5, 1933, were young ones evidently of the previous season and only about half grown. A small one seen on June 14, 1933, was only about two inches in head and body length.

Uta stansburiana stansburiana Baird and Girard

Brown-shouldered lizards were rather widely distributed over Smoky Valley and the adjacent lower slopes of the mountains at least to 7000 feet. Observations on this species revealed activity through the month of May, as follows.

On May 1, 1930, near South Twin River, 6500 feet, several were seen in the middle of the day about rocks and clumps of sage close to camp. They moved rather sluggishly, but each was able to run to a hiding place when disturbed. On May 4, in the same vicinity, many were out on rocky ground

in the morning although the air was cold and there was a cold wind. The sun was shining part of the time and the rocks felt much warmer than the air. At noon on May 6 and again on May 10, when the sun was shining, several lizards were among sage bushes on gravelly ground. When pursued they sought refuge beneath stones or at the bases of sage bushes. They could run rapidly even though the air was cool. On May 12, the first warm day in 2 weeks, many individuals were active among the sage bushes. Usually when pursued, one would leave its temporary refuge in a bush twice before it would hide. One that was killed contained 4 eggs each about 10 mm. long.

On May 17, 1930, several brown-shouldered lizards were seen on sandy ground at the bases of sage bushes 5 mi. SE Millett. Several were found on rocks and on the ground among sage bushes near Ophir Creek, 6500 feet on May 18, 1930. On May 22, near Wisconsin Creek, 7000 feet, one, when disturbed, ran beneath a sage bush.

Near the lower end of Last Chance Creek, on May 23, 1932, about 50 brown-shouldered lizards were seen among large rocks and sage bushes. Most of them sought refuge in the bases of bushes. A female that was shot contained 4 eggs about 7 mm. long. On May 27, near South Twin River, 6500 feet, this species was abundant. About 50 were seen in half an hour after 8 a.m., on gravelly ground among sage bushes. In the hour before noon several were seen on top of dark rocks in boulder piles.

Sceloporus graciosus graciosus Baird and Girard

The mountain swift was found near the center of Smoky Valley up to at least 8000 feet in the mountains. Nature of the surroundings normally occupied is indicated by the following extracts of notes upon particular individuals: at base of sage bush; among sage bushes on sandy ground; close to building; among sage and mountain mahogany; on ground in rose-buffalo berry thicket; on sandy ground among sage and wormwood; along fence through rabbit brush and buffalo berry; among bushes on sand dune area; 2 feet from ground on door screen.

As implied in the notes given in detail above, the usual place of refuge sought upon disturbance was the base of some bush or thicket. This lizard occupied varied types of soil ranging from fine sand to coarse gravel or rocks.

Sceloporus occidentalis biseriatus Hallowell

Blue-bellied lizards, in the Toyabe region, were characteristically animals of the mountains. All our records for this lizard were definitely within the mountains, above a 6000-foot altitude. Here this was the most widespread and most numerous reptile. The dependence upon rocky situations for living places seemed to be nearly complete, for practically every individual was seen on or close to rocks. Sometimes, however, they occupied logs or stumps which seemed to serve almost as well as rocks.

Various examples of encounters with the species illustrate its choice of habitat and the behavior which makes this habitat desirable. On the afternoon of May 1, 1930, one was moving over the outside, eastern wall of an

old rock house near South Twin River at 6500 feet. The flies on the warm rocks were probably objects of the lizard's search although no capture was seen. On May 6, in the same neighborhood an especially dark one on a rock at the top of the cañon wall, near 7000 feet, persisted in coming out into the sunshine although it was driven back repeatedly and even was injured by a shot. May 21 was a cold day, but the rocks were warm; blue-bellied lizards were seen on rocks at 8000 and 9000 feet.

Close to Wisconsin Creek, 7800 feet, on the morning of May 24, a blue-bellied lizard was seen running over walls of a log house.

In mid-June, 1930, numerous individuals of this species were seen in the lower part of Kingston Cañon. These were mainly on rocks at the side of a roadway. On June 16, one moved over bare ground onto a small rock and made a quick pass at something, presumably an insect, on the ground. On the morning of June 18, 10 or more individuals, some in shade and some in the sun, were seen on rocky places at the roadside. On June 20, 3 individuals were seen on a vertical brick wall at the foundation of an old building. Two were close together; one repeatedly pushed its body outward from the wall, but no response was seen.

Activity of blue-bellied lizards at night was noticed in this locality. On June 15, 1930, one, disturbed after dark, ran across the road and into some leaf litter. A search for lizards was made at night on June 17, and several were found among bushes and rocks at the side of the road. These were much less active than ones observed in the daytime.

In the vicinity of Mohawk R.S. not many lizards were seen during the cold weather which lasted for several days before June 21, 1931. Not more than 4 were seen in a 4-day period, but on the last day, which was warm, 6 individuals were obtained along a stone wall less than 50 yards long. Some of these were young ones less than $1/3$ grown.

During a hard snow at noon on May 30, 1930, on a ridge south of Wisconsin Creek, a blue-bellied lizard was seen rapidly pursuing another one over rocks. On another occasion, May 27, 1932, one of several individuals seen on rocks was sprawled out flat, as if to absorb as much as possible of the sunshine. All in this group were dark in color.

Phrynosoma platyrhinos Girard

Desert horned toads were found commonly over most of Smoky Valley, especially in the drier parts and where the soil was sandy. A typical experience with this species was recorded on May 18, 1930, when 4 individuals were taken along a road through low sage on gravelly ground, 5 mi. SE Millett. Each, when disturbed, ran to the base of a sage bush and stopped, permitting itself to be picked up by hand. One that was picked up, May 23, 1933, on the sand in this vicinity was lying flat with legs close to its body. It did not move when being picked up. On one occasion, May 24, 1933, a horned toad was found on hard, white alkali ground. Of 2 or 3 individuals seen on June 1, 1933, one was only about half grown.

Cnemidophorus tesselatus tesselatus (Say)

The whip-tailed lizard was one of the most numerous species of lizard on the desert of Smoky Valley. Its habitat extended to the base of the mountains but not into them. The locality where most individuals were seen was the area of dark, gravelly ground near the road in the vicinity of Birch Creek ranch. Here on June 10, 1930, about 50 individuals were seen on a morning and afternoon trip across the area. This was the most numerous lizard here, 3 or 4 individuals sometimes being in sight at once. Several, mutilated too badly to save, contained eggs. As a rule they kept in the shade of the bushes and held their bodies close to the ground. I had a notion that this animal was naturally swift in all its movements, but all these, when they moved, crawled slowly, remarkably so it seemed to me. This characteristic was noted again on June 26 when about 100 lizards were observed, all moving slowly and with bodies close to the ground.

Contrast with the behavior noted above was observed on May 26, 1932, SE Millett when about 6 whip-tailed lizards were seen on sandy ground among *Sarcobatus* bushes. The ones seen early in the morning (8 a.m.) ran so swiftly they could scarcely be identified. Several sought refuge in mammal holes.

On June 9, 1933, about 20 whip-tailed lizards were seen on the desert close to South Twin River, 6000 feet. There seemed to be more individuals on gravelly ground than on fine soil. About half the ones noted on that date were young, partly grown ones. When moving voluntarily from bush to bush the large ones kept their bodies and tails pressed close to the ground and crawled slowly; they hurried only when frightened. In this vicinity on June 18, two large individuals were seen under the same bush. Again it was noted that when frightened they ran with their tails off the ground; otherwise they moved with tails dragging.

Eumeces skiltonianus Baird and Girard

Western skinks were recorded in the Toyabe region at only three localities and in those places on infrequent occasions. On May 12, 1930, a partly dried young individual was given to me that had been found a few days before by road workers who were grading the road up Kingston Cañon.

On the afternoon of June 18, 1931, a skink came into the house at Mohawk R. S. It was frightened and ran quickly down a hole in the floor. On June 21, between 9 a.m. and noon, 5 skinks were shot and at least 1 other was seen, all within 15 feet of the northeast corner of this house. They were active along the east side of the house and along the base of an adjacent rock wall. They were much more timid than blue-bellied lizards at the same place. The many clumps of wild rye on this area made it hard to see the lizards until they moved, and then they quickly slipped away among the rocks.

On July 6, 1931, along North Twin River, 6500 feet, a skink was seen, but not captured, in midafternoon in leaf litter on rocky ground beside a trail in the bottom of the cañon. As soon as it was disturbed the animal

began a violent twisting of its body, making a noise in the dry leaves, and soon working its way out of sight into a crevice.

Charina bottae (Blainville)

Five rubber-snakes found in the Toyabe Mountains constitute all the records of this species in central Nevada. Lamb found one at dusk on May 24, 1930, stretched at full length in a gravelly roadway about 15 yards from Wisconsin Creek at 7800 feet. Compton found one early in the morning of May 26, 1933, in a similar situation beneath the canopy of birches along summit creek, 6800 feet. Three individuals came from Kingston Creek. At 8:05 a.m. on June 10, 1930, one was picked up from the wooden floor of a bridge at 6400 feet where it was stretched at full length. On June 15, in the evening just after sunset when the air was warm but much cooler than it had been in the afternoon, one was found stretched out on rocky ground close to the road and six feet from the water of the stream at 7000 feet. Another was found close to this place at about the same hour the following day. It too was stretched out on a roadway. These occurrences all support the opinion that this snake comes out of concealment here at about sundown and gets back under cover again early in the morning.

Coluber taeniatus taeniatus (Hallowell)

Six specimens of striped racer were obtained, and several individuals were seen which escaped, in the Toyabe region. Most of them were found along the margin of the valley close to the base of the mountains. On May 12, 1930, at 11 a.m., a racer was found near South Twin River, 6500 feet, coiled loosely in an open dead sage bush the stems of which it matched closely in color. It kept quiet while I stepped on it and picked it up. On this day the air was warm for the first time in at least 2 weeks. In this vicinity, in late afternoon on July 6, 1931, a small individual was shot in brush along a trail beside the stream in the bottom of the cañon. Two adults were found, not more than a foot apart, in a rock pile at the margin of an alfalfa field in this neighborhood on June 9, 1933, and one was obtained here the day before that (Compton).

On the lower part of Wisconsin Creek two striped racers, one small and one large were shot, July 5, 1931, in the shade beneath a brushy thicket close to the stream. Attention was directed to the larger one by the noise it made in crawling over the ground, 8 feet away from me.

On June 20, 1930, a striped racer was shot at the ranch near the lower end of Kingston Creek. It was among small, scattered bushes close to the creek on rocky pasture land. When injured, it started to crawl down a crevice in the rocks. Another that was seen close to the road, 3 mi. N Birch Creek ranch, on June 10, 1930, escaped by crawling down a hole.

Pituophis catenifer deserticola (Stejneger)

Gopher snakes were widely distributed over Smoky Valley and in the Toyabe Mountains up at least to 7000 feet. Encounters with the species on the desert, 5 mi. SE Millett, were as follows. On May 18, 1930, one was

found coiled beneath a sage bush. It crawled farther beneath the bush when disturbed. On May 18, 1932, 1 was found stretched out in a small cattail marsh only 2 feet from a marsh hawk nest, which held 2 eggs, 2 young, and a brooding female. It was almost certain that the snake was on its way to make a meal at the nest. On another occasion, June 15, 1933, a large one was seen in another cattail marsh in this vicinity. Circumstances seemed to indicate that this species was responsible for the disappearance of the contents from several bird nests in the area.

On May 19, 1932, a gopher snake in this vicinity was seen on bare ground close to a spring. When approached it slowly crawled off into a rose thicket, several times raising its head and projecting its tongue. Two gopher snakes came into the old adobe house at this locality on May 25, 1933, and another a few days previously. On June 5, 1933, one was seen on a road on the desert 4 or 5 mi. S Millett where the only vegetation for at least 2 miles in any direction consisted of scattered desert bushes. This showed an independence of water on the part of this snake. Another one, found in the evening of June 16, 1933, out on the desert, struck at me as I approached it.

All the specimens obtained in the mountains were found in cañons close to streams.

Thamnophis ordinoides vagrans (Baird and Girard)

Garter snakes in the Toyabe region nearly always were found in the near vicinity of water. In Smoky Valley they were seen about the marshy areas and close to the springs. Here individuals usually found protection, when disturbed, by crawling into the brush fences which surrounded the water holes. Sometimes they were found in herbaceous or grassy vegetation on marshy ground. One that was found in the evening on June 16, 1933, on dry ground was reluctant to leave; it struck violently each time a pebble was thrown toward it. Two seen close together on May 21, 1933, escaped by crawling down holes in the ground.

On June 18, 1930, near Kingston Creek, 7000 feet, a garter snake was seen among rocks at the base of a cañon wall. At first it attempted to escape by crawling beneath a rock. When the rock was overturned, the snake flattened itself and puffed out its body. Finally it moved out of sight beneath another stone.

Garter snakes were seen frequently on the wet ground in the meadows on Kingston and Birch creeks.

Crotalus confluentus lutosus Klauber

Four rattlesnakes, obtained in the Toyabe area, were found close to the base of the mountains along the western margin of Smoky Valley. According to local testimony this species never occurs high in the Toyabe Mountains. Many individuals were reported as living in alfalfa fields where they found favorable food supplies. Their presence here made the finding of them by persons more certain.

On May 27, 1932, along North Twin River, 6500 feet, a rattlesnake was

found in a roadway just above the mouth of the cañon. The snake started to move off slowly as I approached. It was shot and badly crippled but not killed. After a few moments the snake opened its mouth widely and grasped its own body about 9 inches back of the head and sank both fangs to their bases in the middle of the back. After 2 or 3 minutes the fangs began to withdraw slowly.

Birds

Colymbus nigricollis californicus (Heermann)

Eared grebes are to be found in migration seasons on the small ponds and spring pools in the lower part of the valleys. On May 14, 1930, a single grebe was watched on a small pond 4 mi. SE Millett. In midmorning it was swimming slowly and diving occasionally.

Ardea herodias treganzai Court

A skull of a great blue heron was picked up January 10, 1927, by Miss Alexander at 5 mi. SE Millett. On June 2, 1930, a heron flew up from one of the larger ponds in that neighborhood. During the last week of May, and in early June, 1933, a single great blue heron was seen daily about the ponds and marshy areas there. Another specimen was taken on September 15, 1931, at San Antonio. These records indicate that this species occurs infrequently in the lower valleys of the Toyabe region. Whether or not the species breeds there was not determined. No satisfactory evidence that it does was obtained.

Casmerodius albus egretta (Gmelin)

Two American egrets were seen on the morning of June 2, 1930, standing close together at the margin of a pond 5 mi. SE Millett. Later the same day they were seen in shallow water of a smaller pool.

Egretta thula brewsteri Thayer and Bangs

The snowy egret was recorded from the region on June 7, 1932, when one was obtained (Orr) as it prepared to light after being disturbed from a patch of willows, whose bases were covered with flood water averaging one foot in depth. This pond was near the center of Smoky Valley, 6 mi. SE Millett. A small group of black-crowned night herons also used the willow patch in this pond as a daytime resting place. Two snowy egrets were seen together on the mornings of May 25 and 30, 1933, near wet ground in the same vicinity.

At 6 o'clock on the morning of June 15, 1933, a snowy egret was feeding in open water, deep enough to cover the full length of its tarsus, in a pond in Smoky Valley. The whole body of the bird shook vigorously as if from cold. When disturbed, the bird flew up, circled several times, and left toward the southeast.

Nycticorax nycticorax hoactli (Gmelin)

Black-crowned night herons were noted in summer, in Smoky Valley, 5 mi. SE Millett, as follows. May 17, 1932, 3 (2 ads. and one im.) standing

together in water on flooded pasture. June 7 and 8, 1932, 4 and 6 (all im.) disturbed from their day-time resting place in willow clumps, 10 feet high and surrounded by flood water. May 18 to June 3, 1933, 1 or 2 noted almost daily during this period, mainly about margins of ponds.

On the morning of June 2, 1933, a night heron flew up that attracted the attention of a marsh hawk which dived at it. The heron squawked loudly but gave way very little to the hawk. The hawk dived at the heron 4 or 5 times, missing it each time by about a foot. The heron appeared not to fear the hawk, but rather it resented being thus disturbed. The hawk made no serious attempt to catch the heron, but the latter twice dropped for 3 or 4 feet.

A night heron was seen, on June 22, 1933, at a pool in Reese River close to the Lincoln Highway. When disturbed the heron flew to the bare, paved roadway. Here it was pestered by a red-winged blackbird until it flew off, toward the south.

Botaurus lentiginosus (Montagu)

A bittern was seen, on May 18, 19, 20, 24, and 30, 1933, in Smoky Valley, 5 mi. SE Millett. Usually it was in or at the margin of one of the numerous pools in that vicinity. On the morning of May 18, it was at the south end of the pond where yellow-headed blackbirds nested. When wading through grasses, which came to the middle of the body, its head was held nearly vertical, at a 45-degree angle, or lowered to a horizontal line. Once it shook its body and feathers vigorously. It flew across the pond and lit with a loud splash. Then, after an hour it walked back around the edge of the water. On the afternoon of May 30, a bittern was flushed from the same pond when a strong wind was blowing. The wind appeared to buffet the bird about as it flew. Sometimes, when disturbed, the bittern flew to a clump of cattails where it sought concealment. The above observations may involve several individuals, but I suspect that they pertain to one only. Conditions in the valley were attractive enough to hold for a few days individuals on their northward migration, but the suitable habitat seemed to be too small to provide permanent nesting quarters.

Plegadis guarauna (Linnaeus)

The white-faced glossy ibis was observed only as a transient in Smoky Valley, but it may nest in the Toyabe region in some years. Several times, before a storm early in the morning of May 21, 1932, a flock of fewer than 12 birds was seen in flight over the reservoir 7 mi. N San Antonio. On the morning of June 2, 1930, 11 individuals were observed at one of the larger ponds, 5 mi. SE Millett. At first the birds were scattered and feeding around the margin of the pond. When disturbed, they joined together in a flight which lasted for several minutes. The flock tended to form a V, but it was continually changing in formation. The group flew low over the pond several times, single birds occasionally giving a harsh, single-syllabled note. Then it went high into the air. A little later a loud roar of wings was heard as the whole flock plunged nearly straight downward. There was a pause, followed

by a second dive, a pause, and a third dive, but the birds did not alight. Later the group was seen at the edge of another smaller pond.

Anas platyrhynchos platyrhynchos Linnaeus

The mallard was present in summer, at least, about the springs and marshy pools in Smoky Valley. Dates of observation range between April 22 (1930) and September 10 (1931).

Usually in spring noted singly or in pairs. Pairs composed of a male and female were definitely recorded on the following dates. April 26, 1930, May 17, 19, and 20, 1932. All these records probably represent late nestings for this vicinity, for normally the birds would be expected to be incubating by this time of year. On May 29, 1932, a male mallard was watched (Orr) on a pond at 7:45 a.m. It was foraging on the surface and occasionally sticking its head below the water and pulling at stems of *Scirpus* there. Calls, heard from a patch of cattails, were thought to be those of a female, although none was in sight. These were heard again when the male flew away 15 minutes later. At noon a female was seen to leave this pool after being disturbed by a gunshot near by. Calls were heard here at other times, but no nest was found.

On May 20, 1932, a mallard's nest was found in cattails by a spring. The top of the nest was about 7 inches above the water. The outer part was composed of cattails, the cup being broad and shallow and lined with grass stems. The diameter of the nest was 7 inches. It was screened by broken dead cattail stems which covered it almost completely. The brooding female flew when a person (Orr) came within 2 steps of the nest, after having trampled all the rest of the patch of vegetation. The 11 eggs were left uncovered although a deposit of excrement was left upon them by the bird, presumably when leaving the nest. The bird flew about 75 yards and lit in a small marshy pond. On the morning of May 22, the brooding female left the nest when approached within 2 steps. This time it fluttered away on the ground for about 50 yards with 1 or 2 low calls. On May 27, the nest was empty except for broken egg shells. Apparently the young had hatched and left safely.

On May 16, 1932, a family group of about 7 downy young mallards was seen feeding in shallow water at the margin of a pond. The birds were swimming among patches of mare's-tail (*Hippuris vulgaris*). They finally went into a thicket of cattail. No parent was seen with the brood.

At a spring, on May 22, about noon another group of an adult female and 8 young was found. First, a rustle was heard beneath a clump of willow at the edge of the pool. A movement by a young bird was noted; then after moving for a better view, I could see the whole brood facing me and "frozen." The birds held their position for about 2 minutes. Then 1 or 2 moved slightly. Next, I noted the female frozen with head down, about 2 feet from the young ones. Finally the young birds fluttered into the willow clump, and the parent fluttered slowly off over the ground for about 50 yards, in manner

almost exactly as did the bird which was frightened from the nest of eggs a few minutes later on the same day.

In 1933 several pairs of mallards nested in Smoky Valley, 5 mi. SE Millett. On the morning of May 19 a pair was seen lighting in a pond. A male that was flushed from the edge of this pond on May 23, was followed within a minute later by a female from cattails and willows less than 10 feet away. Both birds circled several times together, the quacking of the female being much the deeper and louder. Then they lit in a pool 75 yards off where the female kept up the calls continuously for about 5 minutes. Later the male alone flushed from a pool. On June 16, at 6 a.m. a female on this pond flew from the marshy part to open water and flapped her wings repeatedly and quacked. Then she flew back to the cover of vegetation. When in the open, the duck was pursued by male red-winged blackbirds.

On the morning of May 24, a female was seen on 1 pond with at least 6 downy young.

A nest containing 9 eggs was found on June 6 (Compton). It was on a hummock of sedges and grass about 4 feet across. The bottom of the nest was about 8 inches above the water of the marsh. Materials in the nest were broken pieces of sedge mixed with feathers from the duck. An approach to the nest was composed of broken and matted sedges leading from the water to the nest margin. This tunnel was worn nearly as smooth as a *Microtus* runway. When the female was frightened from the nest it did not cover the eggs but flew straight away for about 10 feet and then dropped and fluttered and splashed along a slough for 50 feet, until it disappeared in grasses and sedges. When followed, she was found about 100 feet from the nest. The bird returned 45 minutes later, but it did not go onto the nest. The eggs had not hatched by June 10.

Dafila acuta tzitzihoa (Vieillot)

The pintail was found in small numbers, pairs or lone individuals, in Smoky Valley, 5 mi. SE Millett.

At one of the larger pools, below a spring, a male and female were seen on May 13 and 14, 1930, and May 16, 1932. On the last date the birds swam close together out in the open water. Both were feeding by tipping. When one reached far down with the body nearly vertical, the tail was held at a right angle with the body axis, parallel to the water. When one (male) did not reach so far, the tail was usually dipped beneath the surface of the water. The feeding position was maintained by rapid, alternate strokes of the feet. Each tip-up occupied from 10 to 20 seconds (estimated). When the observers moved from behind the screen at the margin of the pond and 30 yards away, the birds became alert and smoothed out their plumage, flipping the wings. Then both flew off together.

On May 31, 1932, in the main stream and in one of the deeper parts of a flooded pasture a female flew up and fluttered along on the surface of

the water. The bird behaved as if it had left a nest or young, but a lengthy search revealed no trace of either.

A lone male was seen, June 8, 1932, standing on wet ground among sedges between 2 ponds east of Rogers. When approached within 50 yards, the bird walked off rapidly through the vegetation. It flew when the intruder was 20 yards away. Eight or more feathers lay on the ground where the duck was first sighted. Evidently molting was already well begun.

Nettion carolinense (Gmelin)

The green-winged teal was recorded on May 22, 1932, when a pair was seen on a pond and later on a spring with a small group of cinnamon teal, and in 1933 on May 19, 21, and 23, when single pairs or small groups were seen in Smoky Valley, 5 mi. SE Millett. Once 3 males and 2 females were seen on a pond with cinnamon teal, but they flew off separately.

Querquedula cyanoptera (Vieillot)

The cinnamon teal was present in summer on the springs and ponds in Smoky Valley. Most often seen singly or in small groups composed of several pairs. Sometimes these birds swam about in open water, but more often they were found concealed in the screen of some kind of vegetation. Although definite evidence of the breeding of the species on the area was not obtained, the presence of many adults through the whole summer indicates that many pairs nested there.

This duck was seen sometimes in association with other species. For example, on May 20, 1932, one was flushed from a marsh with a female mallard and flew off, the teal in the lead. On May 22, a pair was noted on a pond in company of a pair of green-winged teal.

That this species fears the marsh hawk was suggested on May 18, 1932, when 2 pairs of teal were being watched on a marshy pond. When a marsh hawk flew over, although it made no effort to capture them, the ducks hurried to a near-by patch of cattails. They came back to the open water about one minute after the hawk left (Orr).

Nyroca affinis (Eyton)

The lesser scaup duck was a transient across the lower valleys of the area. On May 20, 1932, at the south end of the reservoir, 7 mi. N San Antonio, a male was identified swimming in the evening in company of 2 ruddy ducks. This bird was still there on the following morning. Most of the time, before an early morning snowstorm, it was in the lee of a bank, swimming in circles with its head tucked beneath the feathers of its back.

Erismatura jamaicensis rubida (Wilson)

The ruddy duck is resident in summer in the lower valleys of the area when sufficient water is available. In 1932, on May 20 and 21, a male and female were seen swimming together and occasionally diving at the southern

end of the reservoir, 7 mi. N San Antonio. On June 8, 2 pairs were watched on a group of ponds east of Rogers. At first 3 ducks swam over and joined a lone coot. They then flew to the next pond where a fourth duck was swimming. While 3 birds swam about, part of the time, with their heads tucked among the feathers of their backs, the fourth, a female, seemed more active, and frequently it dived for food. This difference in activity may have indicated breeding activity—the single bird may have just come from a nest.

On August 20 many individuals were seen on an alkali pool 3 mi. SE Rogers. When disturbed by a person walking near, the ducks swam toward the middle of the lake.

Mergus serrator Linnaeus

Observed once in Smoky Valley; on May 14, 1930, a female red-breasted merganser was seen in midmorning in the open water of a spring pool.

Cathartes aura teter Friedmann

The turkey vulture was noted almost daily in summer in soaring flight over Smoky Valley and the lower part of the mountain range. Usually only 1 or 2 were seen at one time, but occasionally, especially at feeding places, groups of more than a dozen individuals would be seen together. Such a group was seen, June 1, 1932, at 8:30 a.m. along the road north of Millett. Apparently, this species found nesting sites on the cañon walls in the mountains and foraging places in the valley where carcasses of large animals were more likely to be found.

Whenever a turkey vulture came near the nest of a marsh hawk, one of the latter was sure to fly up to drive away the intruder. Such encounters were seen on May 18 and 20, and June 8, 1932. Always, the vulture seemed to retreat directly before the drives of the smaller hawk.

On June 21, 1930, at 7300 feet in a side-cañon near Birch Creek, a turkey vulture was disturbed from its resting place, in a tree. The bird returned within a few seconds and perched on a point of rock on the cañon wall. Afterward it flew in small circles just over the tops of the trees. From the behavior of this bird, it was judged that a nest was located somewhere on the cañon wall.

Accipiter velox velox (Wilson)

Four specimens of sharp-shinned hawk were obtained, as follows: Male and female, Birch Creek at 7000 feet, September 1 and 3, 1931 (also observed June 21, 1930); male, North Twin River at 6300 feet, April 30, 1930; South Twin River at 6500 feet, May 11, 1930.

In addition to the localities represented by specimens this hawk was seen at the following localities: Kingston R. S., 7500 feet, June 15, 1930; Kingston Creek at 6500 feet, September 4, 1931; Mohawk R. S., June 17, 1931; Last Chance Creek, 8000 feet, May 23, 1932; 5 mi. SE Millett, May 13, 1930.

Several observations demonstrated the manner in which this hawk takes

small birds for food. The female that was obtained, May 11, 1930, on South Twin River, came in response to squeaks in a course directly over the collector who was standing in an open field. Bush-tits gave warning cries at the near presence of a sharp-shinned hawk near Kingston R. S., on June 15, 1930. At Birch Creek Meadow, on September 1, 1931, a hawk was seen in the morning, carrying a small bird.

Sharp-shinned hawks were usually seen singly (or in pairs in the nesting season) about thickets of mountain mahogany on the ridges, or aspens, willows, wild cherry, or other brush near the streams and in the cañons. In their flights, however, they were seen in all types of surroundings, even out over open ground.

Nesting pairs of this hawk showed much concern when their home grounds were invaded. On May 23, 1932, a pair that was watched on Last Chance Creek, appeared to have a nest close by, but none was actually found. The birds were perched in leafless aspens at an 8000-foot altitude. Each bird moved, but did not leave the vicinity, although I stood less than 50 feet away. The female remained perched nearer to me and gave series of soft, high-pitched notes of protest.

On June 17, 1931, near Mohawk R. S., a hawk came flying overhead in response to alarm cries of a pair of hairy woodpeckers. It gave a few calls and perched in a clump of mountain mahogany, high on a near-by ridge, and then left.

Two nests of the sharp-shinned hawk were found and sets of eggs taken from them in June, 1930 (Lamb). One set of 3 eggs in which incubation had just begun was found on June 5, in Mahogany Cañon, near Kingston R. S. The nest was 15 feet above the ground in a mountain mahogany. The second nest was found on June 21, in a side-cañon near Birch Creek Meadow. It was 20 feet above the ground in a birch tree growing among birches and aspens and was in a crotch among some dead limbs. An adult was brooding 3 heavily incubated eggs.

Another nest was found on May 26, 1933, close to Summit Creek about 6800 feet. At this place there were 2 nests in birch trees, an old one 12 feet up and empty, and a new one 20 feet up, also empty but newly built. On June 13 an adult sharp-shinned hawk was brooding on the latter nest at 7 a.m. The bird did not leave when I walked about beneath the tree. In the evening both birds of the pair were present, flying about beneath the canopy of the trees and protesting at the presence of persons.

Accipiter cooperii (Bonaparte)

The Cooper hawk is a resident which forages over the whole area, but which nests only in the mountains.

Two females were preserved as specimens: one from Birch Creek, 7300 feet, June 21, 1930; the other from 5 mi. SE Millett, September 11, 1931. A Cooper hawk was observed at one other place in the Toyabe Mountains, near the head of Mohawk Creek, on June 19, 1931.

More individuals, evidently young ones, were seen in the fall and in a

greater variety of location than in summer. On August 30, 1931, at 7500 feet altitude on Birch Creek, one, which called continuously for about 15 minutes, was seen in a group of aspens. The bird permitted me to approach to within a few feet, but even then it kept its perch. When finally frightened, it flew in a small circle and again alighted close by. Another young one was seen in willow clumps near the same creek on September 1. It was not wild and did not fly when approached to within 15 feet. On September 8, 1931, one was found perched on top of a buffalo-berry bush and flying high in the air at mid-day, in Smoky Valley, SE Millett. On September 10, on brushy ground in this vicinity one was seen carrying a small mammal.

That some kinds of birds recognize the Cooper hawk as a potential enemy was demonstrated on June 20, 1930, at Birch Creek Meadow, where one was actively pursued by Brewer and red-winged blackbirds.

A nest of the Cooper hawk was found, June 21, 1930, near Birch Creek, 7300 feet. It was about 50 feet up in a cottonwood, in a crotch made by a limb at a 30° angle with the main trunk. The nest was near the top of the tree, the crown of which had not yet leafed out. The nest-tree was taller than others (cottonwoods, aspens, and birches) in the cañon. The parent (female) flew from the nest when I approached; it lit in another cottonwood close by, where it gave alarm notes—1 or 2 short screams followed by series of loud, clear notes suggesting those of the flicker in quality. Next, the bird circled just above the trees in a radius of 3 yards. It left and, within a few minutes, returned carrying some food in its claws. It gave more alarm notes from various perches. Once it swooped rapidly over me and sailed near the nest. Two or 3 minutes later it flew directly to the nest. From the side of the cañon I could see at least 3 small young hawks in the nest. They spent much of the time, in the 15 minutes, picking at themselves.

Buteo borealis calurus Cassin

One specimen of western red-tailed hawk, a skeleton, was obtained from the Toyabe area. It was taken July 12, 1929, 12 mi. E Austin, along the Lincoln Highway.

Red-tailed hawks were seen in flight in practically every part of the area from the valleys to the highest parts of the mountains. However, the mountains appeared to be the true homes for the birds. That is, they rested and carried on most of their major activities on the mountain sides and in the cañons. Perching birds sometimes were seen in trees, piñon or limber pines, but rocky cliffs provided the main homesites and most of each bird's time was spent about them.

In their long flights the red-tails occasionally encroached upon ground belonging to other birds and thus became objects of pursuit. Examples were noted most often in the case of the marsh hawk. On April 20, 1930, at 5 mi. SE Millett, a red-tail was pursued by a marsh hawk. Each time the smaller bird dived at it, the red-tail turned in the air to ward off the attack, but it made no effort to leave the vicinity. Again, on May 18, 1932, one in the same vicinity was being pursued by a marsh hawk but with no apparent effect.

On May 26, a red-tail was seen to fly directly over a marsh hawk's nest in this locality. Both the male and female marsh hawks went after the intruder, swooping at it until it flew away. No attempt was made to return the attack. Sometimes small birds showed concern at the presence of this large hawk. On June 22, 1930, one in flight high over Birch Creek Meadow was being pestered by 2 blackbirds but, apparently, with little effect. Another time, the same day, a group of blackbirds drove a hawk away from this vicinity. The moment a red-tail flew from its perch on the side of the cañon at Wisconsin Creek, June 4, 1932, 4 Clark nutcrackers began chasing it, but none succeeded in touching it. After a minute the hawk lit, as also did the smaller birds, but as soon as it moved again the nutcrackers started after it.

Air currents through the cañons and over the ridges in the mountains seemed to favor the soaring type of flight of this hawk. Once, in May, one was watched as it poised over the top of a ridge, facing a strong wind, and for half a minute or so, appeared to hold its position with only a slight movement of the wings.

Near Kingston R. S., on June 12, 1930, a nest with large young (number undetermined) was seen in a pocket near the top of a cliff where a side cañon had cut through rock beds at 8700 feet. An adult red-tail flew off and gave loud calls. Two adults were seen in the vicinity on the following day.

On June 20, 1930, a red-tail was seen to leave a nest on the face of a 25-foot cliff near the top of a small cañon near the mouth of Kingston Cañon (Miller). The nest was situated on a ledge 8 feet down from the top of the cliff and about 15 feet from the bottom. The ledge was about 2 feet wide and 4 feet long, the nest occupying only half its length. One corner of the nest was overhung by a projecting piece of the rock which composed the cliff. The nest was composed chiefly of sage brush bark, but there were several twigs of cottonwood and branchlets from piñon trees. There were few sticks in the nest, but at the base of the cliff there were enough sticks to have made a second nest of the same size. Apparently the birds had had trouble in lodging the nesting material on the ledge. The nest was well flattened out, no cup being in evidence, and it was only about 6 inches thick.

A few red-tail feathers and scraps of fur were the only animal remains in the nest aside from the hind-quarters of a young cottontail rabbit which was fresh, evidently caught the same day. At the base of the cliff were the remains of a mountain quail—the hind part only and that well picked of meat and feathers.

There were also remains of young ground squirrels (*Citellus mollis* and *Callospermophilus*). Only parts of these had been eaten, the heads and anterior fur being intact, but the visceral cavity had been opened and cleaned. Also, shells of 2 eggs were found; one appeared to have contained an unhatched embryo, the other a cleanly broken shell such as is left after hatching.

On the nest the single young bird was sitting beside the remains of the rabbit. It was just beginning to show black wing feathers through the dense,

white covering of down. When first discovered, it was lying flat on its belly near the outer edge of the nest. When touched with a stick, it stood awkwardly and crawled to the corner under the overhang. The bird at no time stood erect, but it rested on the full length of its tarsi. It made positive effort to prevent its being pushed toward the edge of the nest. It became excited as a result of being probed and gave several miniature red-tail screams. Several times it took hold of the stick with its beak and tugged with considerable strength.

The 2 parent birds screamed constantly from the time the observer came within 100 yards of the nest. While he examined the young bird, the adults came within 50 feet as they flew past. They were about equally demonstrative, flying back and forth overhead and screaming continuously. Even after the intruder had left the nesting-cañon, the hawks followed him in an adjacent cañon for half an hour, screamed every few minutes, and they lit close by on the tops of piñons. One of the adults was especially light in color. It appeared to lack all markings on the under surface.

Buteo swainsoni Bonaparte

A female Swainson hawk was shot, August 20, 1932, 7 mi. N San Antonio. This bird was found before sun up, perched on top of a post at the margin of a dried-up reservoir.

Swainson hawks were seen regularly, from April to September, in Smoky Valley, SE Millett. Single birds were seen, often in flight over the ground covered with buffalo berry. At other times as many as 3 or 4 would be seen perched on tops of adjacent fence posts around a large pasture. It was thought that these birds which stayed in these small groups through the summer (3 on August 19, 1932) were probably families that had not yet separated.

This hawk sometimes drew unfavorable attention from smaller birds. On May 15, 1932, one was perched in the top of a tall bush and was being vigorously mobbed by 2 black-billed magpies. On June 8, 1932, one that was on its way over a nesting colony of yellow-headed blackbirds was pursued by about 10 of those birds. It dived at a blackbird but did not reach it, and then flew on toward the north.

Several nests, all about 8 feet above the ground, in tall buffalo-berry bushes, were thought certainly to belong to Swainson hawks, but none was found while it was occupied until 1933, when 4 occupied nests were discovered. Three of these were in a small area 6 mi. SE Millett. The first was found on May 18. It was built on an old magpie nest in a buffalo-berry bush and contained a single egg. Both adults were near, one of them being perched on another old nest of magpies, 50 feet away. This nest contained 2 eggs on May 22, and incubation apparently had started. Two adults were seen near by. On May 31, this nest was empty and there were some traces of broken eggs on the twigs. No hawks were seen in the vicinity. Evidently some animal had discovered the eggs and had eaten them.

On May 22, a second nest was found in this neighborhood. It was about

8 feet above the ground, built above the dome of an old magpie nest, and was in the middle of a thicket of buffalo berry and gooseberry bushes. When a person came within 200 feet of the nest, the incubating bird stood up, and after 15 seconds it took wing. It soared and screamed overhead while the nest was being examined and then left the vicinity. In the nest were 3 eggs. On June 4 a brooding bird flew off the nest. In the bottom of the nest was a freshly broken branch of rose or *Ribes* with green leaves still attached. On June 6 and 10, no hawks were seen near the nest, and it was thought to be deserted.

Another nest found near here on May 30, was 10 feet above the ground in the top of a buffalo-berry bush. The bush was partly in leaf at that time. It was the tallest one within 40 feet and was almost entirely surrounded by smaller buffalo-berry bushes with a few willows. To the south was open ground. The nest was about 1 foot thick and was directly in the crotch of the bush. It was made almost entirely of dead buffalo-berry twigs with a few willow stems. It held 3 eggs. Two birds showed an interest in this nest on June 10 and again on June 15.

The fourth occupied nest was found on June 14, $\frac{3}{4}$ mi. E Millett. Its rim was about 8 feet above the ground in a buffalo-berry bush, and it was about 18 inches deep. Directly below but separate from this nest was an old magpie nest. The hawk nest appeared to be built entirely of twigs of buffalo berry. The bushes in the vicinity were scattered, there being no thickets of any size. The ground cover between the bushes was sparse. The site was about 200 yards from the edge of the large alkali flat in the center of Smoky Valley. Three eggs made up the set. An adult flew overhead and screamed while a person was at the nest (Compton).

Buteo regalis (Gray)

A foot and leg of ferruginous rough-leg picked up, September 8, 1931, at 5 mi. SE Millett, in Smoky Valley, provides the only record for the Toyabe area (Lamb).

Aquila chrysaetos canadensis (Linnaeus)

Golden eagles were recorded on 10 occasions at localities ranging from Smoky Valley, at 5500 feet, to Bunker Hill, at over 10,000 feet. Usually, 1 or 2 individuals in soaring flight made up the record. Once, June 4, 1932, two were seen perched close together on rocks at the top of the ridge north of Wisconsin Creek. On June 7, 1932, one that came near a marsh hawk nest in Smoky Valley, was pursued by both birds of the pair at the nest. The eagle flew higher in the air and left toward the mountains.

Circus hudsonius (Linnaeus)

During the nesting season marsh hawks were limited to the lower valleys (Smoky and Reese River). They were further restricted, for only a small part of the valley area offered satisfactory nesting sites. In Smoky Valley these birds nested in the small patches of marshy vegetation and the shrubby thickets about the numerous springs and small ponds near the center of the

valley. Apparently the most important factor in this choice was the presence of a screen to hide the nest from ground prowling predators. Aside from this there seemed to be a slight preference for sites in the neighborhood of water or moist ground, but in this region, at least, no good reason showed itself to account for such a choice.

Even though the birds were limited closely to marsh for nesting, they ranged over much other ground. Foraging was done indifferently over any type of ground and the hawks spent much time over the desert, as far away from the nests as the base of the mountain range. In the fall they went higher into the mountains. For example, on August 31, 1931, one was seen flying over the meadow at 7000 feet on Birch Creek. The next day another was seen in the same place. It flew low and circled close over a willow clump several times before it flew away.

On several instances items were noted which illustrated early stages in the nesting cycle. Two females were seen fighting in the air near a nest on May 22, 1933. Once, on May 23, 1933, 2 females were seen in flight over a pond in early morning. One flew low and lit on the bank, while the other circled and dived at the first bird 3 times. The bird on the ground pulled up a bunch of grass in its bill and flew off out of sight. Apparently, it had trespassed upon the nesting ground of another. A similar performance was watched in this vicinity on June 4.

A male's display flight was watched over meadowland on May 28, 1933. The flight consisted of repeated, steep U-shaped dives and ascents to about the same height, each dip accompanied by a series of single, rapid notes. At first the bird was high in the air, and the dips went less than half way to the ground. Later it went lower and dipped nearly to the ground, and finally it lit in the grass, near the basal part of a nest which appeared to be an incomplete one. It was on fairly dry ground where the grass averaged under a foot in height and was about 250 yards from water. A female was flushed from the site on June 6, but the nest was never completed.

Record of nests of marsh hawk found in Smoky Valley, SE Millett:

Date	Contents	Comment
May 14, 1930	3 eggs	
May 16, 1930	4 young	weights 23.5, 35, 109 and 142 gm.
May 18, 1932	2 small young, 3 eggs	3 young, 1 egg on May 29
May 19, 1932	1 egg	4 eggs on June 8
May 20, 1932	4 young, small	
May 24, 1932	3 young, able to hold up heads well	feathered June 8
May 20, 1933	3 young, 1 egg	
May 24, 1933	2 small young, 1 egg	
May 24, 1933	2 eggs	
May 25, 1933	5 young, all downy	2 able to fly on June 15
May 27, 1933	5 eggs	4 eggs on June 10
June 5, 1933	2 small young, 4 eggs	5 young, 1 egg on June 14
June 11, 1933	5 young, smallest in down	in group 6 feet from nest

Marsh hawks in Smoky Valley demonstrated many times that they aggressively defend their nesting area against intrusion by other hawks not only of their own kind but of every sort, even the comparatively harmless

turkey vulture. A rational explanation for this is not apparent. There can be no competition for nesting site, and the competition for food in this particular area seems of small consequence. However it does constitute a threat which possibly is sufficient to account for the origin if not the maintenance of such a habit.

On the very first day that observations were made in the Toyabe region, April 20, 1930, a marsh hawk was seen flying at a red-tailed hawk. It would dive from high in the air and glide rapidly toward the larger bird, but it was not seen actually to strike. On another, similar occasion the 2 marsh hawks of a pair continued to dive toward and scream at the larger bird even after it perched in the top of a bush.

On June 7, 1932, a Swainson hawk came to within 300 feet of a marsh hawk nest. The male marsh hawk began an attack, and the stranger circled back to meet it. The birds clashed in mid-air, then the marsh hawk managed to get above the intruder and they circled away to the west. After a few more dives at the retreating bird, the marsh hawk returned to the vicinity of its nest (Orr).

One time when a long-eared owl was flying about its nest, a marsh hawk which also had a nest near came and dived at the owl. When the owl perched, the hawk paid no further attention to it.

Just before noon on June 7, 1932, both birds of a nesting pair flew high into the air and drove away a golden eagle which flew toward the mountains on the west. On May 30, 1932, a prairie falcon was driven from the vicinity of a nest by a male marsh hawk. The latter circled and flapped its wings constantly and called. It finally drove the intruder away and returned to the vicinity of its nest (Orr).

Pursuit of turkey vultures by marsh hawks was of special interest, for there seemed to be no possible justification for it. Evidently this was an example of misidentification. It provided reason to suppose that the defense was directed against every large bird irrespective of the possibility of injury from the presence of the invader.

On May 18, 1932, a marsh hawk was in the air at 8 a.m.; pursuing a turkey vulture. The hawk kept above and behind the larger bird and persistently followed it, but I did not see an actual strike. A female marsh hawk was seen, May 24, 1932, driving a turkey vulture away from the hawk's nest. Again, on the afternoon of May 29, the same female chased away a turkey vulture that had soared over the nest site. In the strong south wind blowing at that time the vulture appeared to have a decided advantage in maneuvering, just as the hawk seemed to have an advantage over the red-winged blackbirds which pursued it. Merely by sailing on set wings the vulture could keep out of reach of the hawk which was evidently exerting itself—beating the air with rapid wing strokes. The area defended by the hawk was much larger than the one over which it was harassed by blackbirds. It did not turn back until the vulture was at least $\frac{1}{4}$ mile away. Meanwhile the hawk uttered anxious cries different from those heard when it was being chased.

At noon on June 7, 1933, several turkey vultures flew over some marshy

ground where marsh hawks were nesting. One hawk dived at a vulture which hurriedly retreated, but in doing so entered the nesting area of another pair of marsh hawks. The first hawk gave up here and the second two hurried after the vulture which speedily flew to the ground and sought protection beneath some bushes. Later, it moved, but, again, it went to the ground. Even then the hawks persistently dived at it for 3 or 4 minutes, as long as I remained near.

Once on June 7, 1933, when a third individual (female) circled over the nest site of a pair of marsh hawks, the male of that pair drove the intruder from the vicinity. On May 30, 1932, Orr saw a marsh hawk fly swiftly and directly at another bird of its species which flew over its nest site. The intruder flew away at a rapid rate.

Aside from the hawks which frequently came near the nests of marsh hawks, there were many instances of another sort of relationship with birds. These were exemplified by the persistent attacks by the various kinds of blackbirds whose nests usually surrounded each nest of the marsh hawk. Discussion of this topic really belongs in the accounts of the blackbirds since they were most actively concerned, but behavior of the hawks was modified by the activities of the small birds. On a few occasions a marsh hawk was seen to dive deliberately at a blackbird. These dives appeared more like an expression of irritation at annoyance than an attempt to capture the blackbird. Almost invariably, the instant a marsh hawk moved to leave its nest or came near it in returning, a swarm of blackbirds (mainly red-winged) rushed forward and pestered it until the large bird lit, whereupon the disturbance ceased immediately and the tormentors settled on convenient perches to await another move on the part of the hawk. It seemed rather obvious that whenever the hawk was in the air, its attention was directed toward its attackers even if it was not often aroused to the point of retaliation or injured sufficiently to drive it away. Many times hawks were observed to be prevented in this manner from settling on their nests when obviously they had approached with the intention of going directly to the nest. A possible benefit to the blackbirds would be in holding the attention of the hawk and thus preventing the discovery and harm to nest or young by the larger birds. Doubtless, whether justified or not, the blackbirds regard flying hawks as predators.

At a pond in Smoky Valley, on June 2, 1933, a marsh hawk dived at a black-crowned night heron which flew up. The hawk made no determined effort to capture the heron, but dived at it 4 or 5 times, missing it about a foot each time and causing it to drop 3 or 4 feet. The heron squawked loudly but gave way very little to the hawk. It appeared not to fear the hawk but to resent being thus disturbed.

Nests of marsh hawks in Smoky Valley were similar in being placed on or close to the ground or close over water. Usually they were hidden by a screen which increased markedly in effectiveness with the growth of vegetation as the season advanced. Variety in the nests is indicated by the following paragraphs, each a sketch of a single nest.

A shallow mat of grass and bush stems, about 10 inches across and on

top of a flattened grass clump. A freshly broken stem of rabbit brush at the edge appeared to be just recently added, although incubation of the 3 eggs was well along. Site on the ground in center of a rather sparse rose thicket at the end of a long, shallow marshy place. Bushes were about three feet high with intervening spaces sufficient to permit me to walk up to the nest.

Site at least 40 yards from the nearest tall vegetation, some willow clumps. Nest, on open ground where there were hummocks covered with grasses and sedges, 60 cm. across in greatest outside dimension with base of coarse willow sticks. On top of this the nest proper was 30 cm. across and 7 cm. deep in the center and was made of fine grasses packed into a rather thick cup.

Nest in a patch of cattail in the middle of a slough and 25 feet from the shore. Water 6 inches deep. Platform built up about a foot and 18 inches across, its base of small sticks and top of grass and straw. The top was nearly flat and there was no shade.

Another nest only 200 yards from the last and in a similar situation in the middle of a clump of old cattail.

Nest in center of hummocky, grassy marsh 50 yards from a large spring, 30 yards from a large rose thicket, and 30 feet from the nearest dry ground. The brooding female attracted our attention to the nest, when we walked near it, by rising up to look at us. The platform of this nest, which contained eggs, was not so large as the ones which hold young birds.

Site on ground among close-growing clumps of rye grass.

Nest in center of a rose-willow thicket about 80 feet in diameter, on moist ground.

Although we made no special effort to study foraging behavior of marsh hawks, a few opportunities came to watch activities of this kind. That marsh hawks depended upon hearing as well as sight in locating food was indicated by the number of times individuals responded to squeaking sounds made to attract small birds. On April 21, 1930, a hawk came over a thicket 3 times in response to these sounds, but turned back each time. On May 15, 1930, a marsh hawk came around a thicket when I was trying to call out small birds with squeaks. The hawk was flying rapidly and straight toward me. It came within 15 feet before it saw me, quickly checked its flight, and hurried off in another direction.

An especially strong wind, such as was blowing on June 3, 1933, seemed to keep the hawks on the ground. Few individuals were seen in flight and these not for long.

A marsh hawk out in a grassy pasture on June 6, 1933, was seen making short dives at a jack rabbit. The latter hurried for cover, but the hawk did not follow.

Many marsh hawks were watched that appeared to be hunting for food, and many were seen carrying animals which they had captured, but only 1 capture was seen. A female was flying low over a swampy meadow. When the hawk was about 10 feet above one spot, it dived to the ground, emitting a shrill, short call as it did so. Within 5 seconds it rose, carrying a small mammal presumably a meadow-mouse in its talons, and flew away (Orr).

Daily observations on marsh hawks for nearly 6 weeks in nesting time revealed that in this locality the food consisted almost entirely of lizards and mammals. Lizards were brought to the nests more often than other types of food. Positive identification of the food could not be made, but apparently several species in each group were eaten.

A nest was found on May 17, 1932, in a patch of dead cattails and bulrushes where a marsh hawk had been seen several times 2 days previously. The partly built structure consisted of a pile of sticks not well arranged. On May 19, this nest held 1 egg. A lining of grass had been added after the nest was examined on May 18.

That additions are made to nests through the time of occupation is indicated by notes made on May 24, 1932. This nest had 3 good-sized young. In the morning after being harried by a red-winged blackbird the female marsh hawk went to the ground and rose with a bundle of dead grass stems in its bill. As the bird flew these grass stems streamed backward beneath the body for nearly its full length. The bird flew to the top of a buffalo-berry bush and lit, immediately reaching up with its foot and pulling down the grass stems to the perch. After about 4 minutes the bird flew off without picking up the grass. After being chased by blackbirds the hawk went to the ground a second time and flew up with a small bundle of grass which it dropped when blackbirds again chased it. Five minutes later the hawk approached the nest with a large, streaming billful of grass, and started to settle, but after touching the cattails, it rose and flew off out of sight.

At another nest which contained 4 eggs, some fresh green plant material had been added to the lining within a few hours previous to my visit there on June 8, 1932. On May 24, 1933, a female was seen to light on the ground, pull up some grass stems, and fly with them in its bill to a nest. Young in this nest had already hatched. Similar behavior was noted at this nest on May 29.

The long series of observations made at 13 different nests revealed that in this locality the female does all or nearly all of the incubating. Every bird seen at a nest with eggs or young proved to be a female.

All through the nesting period, as nearly as could be determined, the male regularly carried food to the female at the nest. This was noted once on the morning that a first egg in a set was laid. At a nest that was watched on May 29, 1933, the male perched near and circled about the nest for much of the time. On 2 occasions the female flew toward and followed the male, flying a little below him and giving the begging note that is often heard when food is exchanged. This type of behavior may serve, as it appeared in this case, to encourage or stimulate the male to do more hunting.

Early one morning a male brought a lizard and dropped it to the female high in the air. The latter held it, part of the time in flight and part of the time while perched, for 2 hours. Then this female flew from its nest with some object in its bill which it dropped about 150 yards away. Immediately afterward it was seen carrying a lizard in its claws. Possibly it had picked up the one seen earlier and was waiting until the young needed food. Later it was carrying the lizard and also a bunch of grass in its claws.

On 2 occasions in 1 day a male carried extra-large objects apparently parts of rabbits and dropped them to a female. Both were caught, but they were carried much higher before releasing than is ordinarily the case. Another time the same male brought food which was taken by the female high in the air and then began circling. The object was an especially large one. Soon the bird's legs were extended downward full length and the object dropped, but it was recovered within a few feet. This time it was not held for long, and when dropped, it fell to the ground and was not regained. The female went to the nest and uttered begging notes. The male came and circled but did not light.

Early in the morning (6:30) of June 15, 1933, the male at this nest brought a lizard and repeatedly flew low over the nest, uttering a series of notes, but the female was away or, if present, did not respond. After half an hour both adults were flying over the nest, and the female was begging, but food was not seen. At 8:20 the male brought a lizard which the female took, 50 feet above the ground, and carried directly toward the nest. At 8:25 the female flew from the nest, went 100 yards to the southwest and took another lizard from the male. This time it circled over the nest with begging cries. At 8:45 the male again brought food which the female took in the air. Then it perched and 5 minutes later took the object to the nest. The female flew to meet the male at 9:10 but received nothing or only a small object. It continued soaring in circles and begging, but the male left. The female returned to a perch at 9:15 which it left, at 9:38, to meet its mate and catch a lizard dropped to it, which was taken directly to the nest.

On another occasion a male came to its nest carrying a mouse. It circled over the nest, but the female failed to rise. The male then uttered several calls and finally lit on the ground at a distance. Four minutes later the female arose, as did the male, and they circled close together, the female below the male, and a transfer was made. The female took the animal, circled low and lit on the nest. The male circled and flew away (Orr).

A variant from the usual method of transfer of food was noted on June 7, 1932. The male arrived at a nest with a lizard in its claws and swooped down to within 20 feet of the nest. The female flew up and the two circled for about 2 minutes until the female was 50 feet above the male and 100 feet above the ground, when it partly closed its wings and came straight down. When it came past the male, the latter dropped the lizard which was caught by the female 2 feet below. Then both birds flew off 100 yards where the female lit, and the male continued circling. Then the female rose without the lizard and flew over the nest while the male flew higher (Orr).

The various pairs of marsh hawks studied showed variation in their response to human disturbance at the nest. This behavior varied both with change in pairs and, in a single pair, with advance in the nesting cycle. At 1 nest where there were 4 small young, the brooding female flew quickly and quietly up from the nest when I came near it. Later both parents came and uttered loud, rapid calls and dived at me a few times, but they soon left or retired to a distance.

On May 18, 1932, when I approached the site of a nest, the male began to give staccato alarm calls. I waded out and, when within 8 feet of the nest, saw the female crouched there and ready to leave. At my next step the female flew off, and then both adults circled over my head and gave alarm notes for as long as I stayed near. After 15 minutes when I had moved off 75 yards and was in full view, only the male was flying. The nest contained 3 eggs and 2 recently hatched young. At the time of this visit a gopher snake 4 feet long was stretched out within 3 feet of the nest. There was no indication that either of the hawks had detected it. The snake was removed. On May 24 the male at this nest was noisy. If flew to meet me when I was still 100 yards off. Several times at this nest it was noted that the notes of the female were distinctly higher pitched than those of the male. Afterward this male showed special alarm when a person approached, and often it came about $\frac{1}{4}$ mile to meet an intruder and protest at his presence.

At another nest the lack of concern was in marked contrast. There, no adult was at the nest with the young nor did one come while we were present, for about 10 minutes, but one, presumed to be one of the parents, was hunting over a meadow $\frac{1}{4}$ mile away.

One nest was examined which contained 2 small young. The smaller one had probably hatched that morning, June 5, 1933. Both kept making a weak, twittering sound and opened their beaks for food. That they had already received food was shown by the slight traces of blood about the edges of their mouths (Compton).

In the afternoon of June 8, 1932, when 1 nest was visited at 1:30, neither adult was present. The 3 well-feathered young birds were standing on the south margin of the nest in the shade of cattails which were then over my head in height. These green plants shaded only a part of the nest.

At one nest which contained 5 young, three of which showed wing and tail feathers beginning to break their sheaths, the 3 largest ones started off through the marsh. When these birds were feathered and nearly able to fly, all but one left the nest when I approached. They hopped over the marsh various distances up to 15 feet away from the nest. The parents here were more demonstrative, and they came closer in dives than any others that had been watched. The female showed special concern at being disturbed. In the evening of June 15 when the nest site here was approached, 2 young hawks flew up from the cattails. They did not fly steadily but were able to keep in the air. The 2 adults were more than ordinarily demonstrative, and they nearly hit me in their dives.

A nest, examined on June 11, 1933, was in the center of a rose thicket. The male came and protested at my approach. The 5 young, smallest still in down and the largest well feathered, were in 1 group 6 feet from the nest and in the shade beneath a rose bush. The larger ones started to move farther away when I came within 10 feet. The male parent perched on top of a buffalo-berry bush 100 yards away and continued to give a series of alarm notes.

On June 6, 1933, a nest was examined which contained 2 young, about

$\frac{3}{4}$ grown. When they were first approached, the larger one started to leave, but it returned. The other one remained crouched in the nest. They slowly opened and closed their bills at intervals as if they were hot, but the day was cloudy and cool. When a person bent down to touch the young, the large one backed to the edge of the nest and spread its wings. The small one flopped onto its back and drew up its talons close to the body. It struck viciously when a hand was placed near, reaching out for about 8 inches. The young made no sound during this time, but both held their beaks open. At another nest, the same day, 2 young that were still larger threw themselves onto their backs and struck with their talons when movements were made close to them (Compton).

A family group of 5 individuals all in brown plumage was watched on June 10, 1933. The birds were flying back and forth over a grassy field from 5 to 15 feet in the air. One individual was carrying an object (apparently a rodent). When another hawk flew beneath this one, the food was dropped. The lower bird turned ventral side up and reached out with its talons to catch the object, but it dropped to the ground. Both birds then dropped upon it. When they rose $1\frac{1}{2}$ minutes later, neither was carrying the food. Apparently these birds had recently left their nest, and they were hunting along with the adult female.

Falco mexicanus Schlegel

Prairie falcons were present throughout the area, nesting on the cliffs and cañon walls of the mountain sides. A male was taken on April 25, 1930, at 5 mi. SE Millett in Smoky Valley. This bird's stomach was empty. Its testes were small, thus possibly indicating that this bird was a non-breeder.

In the valley, prairie falcons, when not in flight, were most often seen perched on fence posts. In the mountains rocky outcrops on cliffs were the favored perches. Birds on these perches often attracted attention to themselves by their loud screams when otherwise they would not have been noticed.

Relationships to other species were indicated by a few observations. Once, on May 16, 1930, when a prairie falcon flew low over bushes and marshy ground SE Millett, a red-winged blackbird gave alarm notes, and all other birds in the near vicinity became quiet and sought cover. The hawk circled and flew away. A falcon that came near a nest of marsh hawks on May 30, 1932, was pursued by one of the owners of the nest. It flew in large circles and finally left.

The nest sites that were discovered were on cliffs in the mountains. At the meadow, 7000 feet altitude, on Birch Creek, prairie falcons stayed near and evidently nested on the large isolated outcrop of rock at the side of the clearing. Here an especially favorable feeding ground, the meadow, combined with the single rock outcrop, appeared to provide an ideal site for cliff-inhabiting birds. Three falcons were seen here on June 21, 1930; evidently young were out of the nest by that time.

On June 25, 1931, near the mouth of Birch Creek Cañon, 2 adult prairie falcons, and 3 young ones that were able to fly a little were seen high on the cliff. The parents were carrying food to the young birds.

Falco sparverius sparverius Linnaeus

Present throughout the area, sparrow hawks were noted from lowest valleys to tops of highest ridges. Two specimens, a male, taken August 30, 1931, at Birch Creek, 7000 feet, and a female, September 15, 1931, at San Antonio, 5400 feet, in Smoky Valley.

Sparrow hawks appeared to forage indiscriminately over the valleys and ridges. Individuals were liable to be seen several miles away from the nearest place suitable for headquarters. Typical foraging behavior was noted on April 20, 1930, at 5 mi. SE Millett at 5:30 p.m. A hawk hovered several times at a height of about 60 feet; each time it headed into the south wind. Then it flew to the ground at an angle, and from there went to the top of a fence post. On June 16, 1931, one flew up from the bushes close to Mohawk Creek at the western base of the mountains. The bird was carrying some dark mammal, possibly a young rabbit.

One bird was noted early in May, 1930, which persistently kept close to a high cliff in the cañon of South Twin River. Once it gave a shrill cry and dived at a red-tailed hawk that was flying about the cliff. This individual ranged at least $\frac{1}{2}$ mile from this place which seemed to be the center of its activity. Probably it had to go much farther to forage. Evidently the hawk was one of a pair that was nesting in that territory.

On Bunker Hill at about 9600 feet, a family group of young sparrow hawks on the wing was noted, June 11, 1930, at the lower margin of the limber pines. When an *Accipiter* flew over the territory, one of the adults dived at the invader with partly folded wings and flew after it in pursuit for about 300 yards. Dead trees seemed to be the favorite perching places for these birds, at least in the breeding season. Nesting sites were available either in the hollow trunks of trees or in crevices in cliffs.

Dendragapus obscurus pallidus Swarth

Resident; the pallid grouse was present in higher part of mountains but not numerous. Because there are prospects that the grouse may be removed completely from this area by further human occupation, or that its numbers may be increased considerably if greater efforts are made to protect it, observations are given here in detail. Arrangement is by locality from north to south.

At Big Creek on the western slope of the mountains, on August 15, 1932, an adult female accompanied by 2 nearly grown young was seen at a springy place by the creek at 8000 feet. The birds walked over muddy ground beneath trees and shrubbery, and they did not fly when approached within 10 feet. They uttered low call notes, seeming thus to indicate location and to insure against too wide a scattering.

On June 25, 1930, an adult female, weight 875.7 gm., was obtained from the margin of an extensive patch of ceanothus on a ridge near Birch Creek. Later 3 young, almost grown, were flushed in the same vicinity. Wing spread in the adult was 645 mm. Its iris was brown; feet, smoke gray (Lamb).

In the neighborhood of Kingston R. S., 7500 feet, grouse were seen rather

frequently. At 9 a.m., June 5, 1930, on a steep east-facing slope a female was come upon, brooding small, downy young. When I was within 10 feet, the parent started off with low clucks of concern, and the young ran off a few feet. Then after more calls from the parent, the young birds stopped and remained quiet, nearly invisible in separated places. I distinguished at least five. One kept its position, allowing me to pick it up without any effort to escape. Another kept quiet when I stepped near it. The next day an adult was seen on the ground beneath a mountain mahogany in the same vicinity. This one walked off up the slope rather quietly. On June 15, a female was flushed from the ground among scrubby mahogany and *Symphoricarpos* bushes at this same place. It flew 100 feet across the small cañon and lit on a mahogany limb in the open and 2 feet above the ground. As it flew it gave one cluck and after lighting about 6 more. It then sat, moving its head from side to side and peering at its disturber. Apparently young birds were present, but none could be located. When disturbed further, the female jumped to the ground and moved off among the bushes. One hundred feet farther up the hill a male was seen walking across a bare rock slide and gravel below a mountain mahogany. At first it attempted to escape by running rather than by flight, but later it flew.

A group of three, apparently all males, was seen, June 14, 1930, at about 9500 feet, on a ridge south of Kingston Creek. They were in a pure stand of aspens where limber pines were near at hand. They were walking about like chickens among the leaves, quite unconcealed by bushes. The birds flushed separately, one going but 50 feet and coming to the ground, the others leaving the grove. At 9000 feet another group of three was flushed from the tops of aspens.

On June 16 hooting which was attributed to this bird was heard in a grove of aspens. This consisted of a single abrupt note similar in quality to that of the Sierra grouse, but more explosive and given but once (Miller).

A single grouse flushed, May 26, 1933, from the base or a low limb of a piñon near Summit Creek, 7800 feet. On June 13, a male was flushed on open ground next to a wild cherry thicket near the upper limit of trees along Summit Creek, at about 7500 feet. Another was flushed from an open rocky slope near the head of Mohawk Creek, June 19, 1931.

On Wisconsin Creek several grouse were observed in 1930. May 23, one was flushed from an opening in piñon and mountain mahogany on a south-facing slope at 8000 feet. Another ran for a distance on the ground beneath mountain mahogany and then flew. In the evening of May 24, one was flushed at the side of the creek at 8000 feet where there was a moist hillside with willow and rose tangles. On May 28, one flushed from mountain mahogany on an east-facing slope at 9000 feet. It flew about 100 yards and perched in another tree of the same kind. Another flushed twice from the ground beneath mountain mahoganies.

In Last Chance Cañon, May 23, 1932, a female was flushed from a mountain mahogany standing in a snow bank. The bird flew down and across the cañon. Later in the day a male was seen walking in the shade

beneath piñon pines. A grouse disturbed in the afternoon of June 20, 1933, was among mountain mahoganies at 9500 feet on the divide between North and South Twin rivers.

Centrocercus urophasianus (Bonaparte)

Resident; the sage hen is still present in considerable numbers in the Toyabe Mountains region.

On June 14, 1930, 8 sage hens were seen in flight together, at 6 a.m., as they moved from one ridge to another at about 8200 feet near the trail south of Kingston Creek. The birds stayed close together in flight but without a constant formation. The flight was a series of upward soarings broken by short periods of flapping. The place where they were first seen was gravelly and open, covered with low sage. Farther along on the same trail, at 8600 feet, 4 more adults were standing and preening on top of a ridge where the sage was dwarfed. They stood with heads up most of the time, looking at the approaching persons over the tops of the bushes. Once while 2 birds were watching, another one dropped its head and began feeding apparently on something close to the ground.

Two sage hens were noted July 1, 1931, on a sage-covered slope at 8500 feet near Kingston Creek.

Sage hens were observed commonly in the latter part of June, 1931, along Mohawk Creek, on the western side of the mountains. Late in the afternoon of June 18, an adult with a single young $\frac{1}{2}$ the size of a quail was found close to the creek near the ranger station. The young one flew about 50 feet to the edge of the water where it remained still and allowed itself to be picked up by hand. When released, it flew up the slope in the direction the adult had gone.

On the morning of June 19, about 50 sage hens were seen in bunches of 4, or 5, to 10, mixed adults and young. They were at seepy places and on sage-covered slopes around the head of the stream at about 9500 feet. The young were able to fly well and were $\frac{1}{4}$ to $\frac{1}{3}$ grown. When the adults flew they gave low, clucking sounds and, invariably, dropped excrement soon after leaving the ground. When the birds were first found, at a seep, 5 flew up, then 4, then 5 singly, all from the same small area. Evidently the species is not well adapted for concerted group action.

On June 20, about 20 individuals, old and young, were flushed in short sage at 9000 to 9500 feet along one of the branches of the creek. They usually flew up singly, even when in groups. The following day about 10 old and young were seen in the afternoon within a mile below Mohawk R. S. They were in sage brush close to the creek.

Sage hens were noted at Birch Creek on several occasions as follows. June 27, 1931, six flushed on sage-covered slope close to the stream; August 29, 1931, 1 flock of about 50 and several others singly or in small groups seen in midmorning; September 1 and 2, 1931, small groups of six flushed

from grassy places close to streams. All the birds seen at this locality were above a 7000-foot altitude.

On August 15, 1932, a flock of about 6 sage hens flushed from moist ground near Big Creek and flew off to sage brush on adjoining hills.

Persons living in the Toyabe Mountains were generally familiar with this bird, and they furnished considerable information about it. This testimony was uniform that nesting took place on the lower slopes, and that the birds moved into the higher mountains after the time of hatching. My own observations tended to confirm this. Mr. W. A. Smithline at the mouth of Kingston Cañon reported that while tending sheep in the hills north of his place about May 5, 1930, he found 5 nests of sage hen. One contained 9 eggs. Others were occupied but he did not disturb them. The brooding birds always flushed with much fluttering of wings and tail along the ground, thus attracting attention and showing the nest location. The species has become reduced from former numbers in the mountains, but there is a larger population than of grouse. During the previous winter about 65 sage hens, in 2 bunches, regularly foraged on the meadow at this ranch. The birds become remarkably tame and will not fly when not molested. This makes killing of them by hunters too easy and results in much waste. Mr. Smithline reported seeing a group of these birds, with young, in the sage brush south of his place on June 17, 1930.

Oreortyx picta picta (Douglas)

The mountain quail was found in small numbers near the lower ends of Kingston and Birch Creek cañons.

In Birch Creek Cañon, at 6500 feet, a single mountain quail was flushed at the side of the road in the evening of August 28, 1931. A miner that was interviewed in Austin on June 26, 1930, declared that, the previous spring, he had found a nest containing 18 eggs of mountain quail in the hills near the mouth of Birch Creek. This man seemed to be quite familiar with the species. He said he had passed this nest daily (Miller).

Near the mouth of Kingston Cañon, on June 20, 1930, a part of a skeleton of mountain quail was picked up beneath the nest of a red-tailed hawk (Miller). Earlier in the same month a rancher, Mr. W. A. Smithline, who lives near this place reported that, up to a short time previously, a small group of about 9 mountain quail had lived on his place. At that time he considered the species scarcer in the mountains than formerly. Other local residents (Daniels brothers) said that quail, in June, 1930, were much reduced from their former numbers. They thought that, possibly, this bird had been introduced by man into this locality. In the absence of positive evidence in either direction it is not now possible to say whether this bird is native in this locality. It has been able, however, to survive over many years even though in small numbers.

Rallus limicola limicola Vieillot

Only 2 individuals of the Virginia rail were noted. One, a male, was shot 5 mi. SE Millett, May 15, 1930. The bird ran from a shallow marshy pool

to a willow-rose thicket at the margin. It had 12 mm.-length testes. The other individual, also a male from the same locality, was obtained on September 10, 1931. This one was flushed from tall sedges at the edge of a marsh.

On May 20, 24, and 28, 1933, Virginia rails were heard at a cattail-grown pond, 5 mi. SE Millett. Sounds made by this bird were heard several times. First there was a series of squeals and then about 8 notes like the noises made by a young pig with grunts and hoarse, squeaky notes came almost continually after that. Once when a meadowlark uttered alarm notes, a rail that was in the open ran into bushes on the bank and remained there for about a minute. Another time 2 rails were seen momentarily above the water apparently one in pursuit of the other.

Porzana carolina (Linnaeus)

At one of the ponds 5 mi. SE Millett in Smoky Valley, a sora rail was watched for most of the time between 10:30 a.m. and noon on May 15, 1932. There was a patch of dead stems of cattail and bulrush and a larger area of open water. The rail was swimming and feeding in the open water. It would stay away from cover for about 5 minutes at a time and then would seek the screen of vegetation for a short time. Once when the bird was about 10 feet away from any screen, a motion by me frightened it, and it went for cover so quickly my eye could scarcely follow it. For most of the time the rail was feeding, usually picking objects from the surface of the water. At least 3 times it tipped, immersed its whole head and forepart of its body, and brought up some large food object.

Twice during the morning of May 17, a rail was noted for about 3 minutes on this pond. It seemed to stay and to feed mostly where algae covered the surface. When swimming, the bird's head moved in manner like a coot. No sounds were heard from it (Orr).

Again, on May 19, a sora was watched at this pond. At first it swam about in the water near the cattails. Later it climbed out on small islands and foraged among grasses and sedges growing at the bases of willows. When walking on shore, it continually moved its tail up and down in little jerks. Once, it suddenly ran, with head lowered, to a clump of wild rose and gooseberry where it disappeared. At the same time a red-winged blackbird gave a warning call, and then a marsh hawk came into sight and flew overhead. In 5 minutes the rail came out and resumed its feeding along the shore. It darted sometimes as though catching insects (Orr). About noon a shallow, empty nest which may have belonged to this bird was found out in the *Scirpus* near the edge of the pond. The nest was built of coarse stems about 1/16 inch in diameter and appeared to be new. It was a shallow bowl close above the water. Later observations showed, however, that it was not occupied, nor was a rail seen at the pond after the 19th. On May 25, 1932, a sora rail was noted among cattails at another pond in this vicinity.

Coturnicops noveboracensis (Gmelin)

During the third week of May, 1932, we worked in Smoky Valley, 5 mi. SE Millett. Every evening that we walked northwest from the camp we

heard calls which we thought were made by a rail. They always came from the same small patch of dead cattails, about 30 feet across and close to a spring. The water was only about 2 inches deep. When we went close to the spot the calls continued but no bird came into sight. On May 19, we spent more than an hour working through the cattails in an effort to see and identify the maker of the sounds. The calls were made several times within one step of where I stood, but I could see no animal. The calls were so mechanical and came so regularly that for a time we thought they might be given by an amphibian, but the location was changed so often and so rapidly that we concluded that was impossible. Finally, on at least 3 occasions, we saw the bird fly from spots whence calls had come. Always it dropped back into the same cattail patch. At such close range and with fairly good light we were able to judge the size and color of the bird and to identify it as a yellow rail.

Fulica americana americana Gmelin

The coot was a regular transient across the Toyabe region, which was on the border toward the summer resident class. Each summer numerous, scattered small groups of this species stayed on beyond the end of the spring migration, but I was unable to determine that any of them actually nested. In Smoky Valley, 5 mi. SE Millett, coots were recorded as follows: 1930, May 13 and 14, and June 2; 1932, May 16 to 31 (almost daily); 1933, May 18 to 28. In the same valley, 3 mi. SE Rogers, they were numerous on a shallow lake, August 20, 1932, and several were seen June 7, and 8, 1932, near Rogers. At the reservoir, 7 mi. N San Antonio, coots were noted on May 20 and 21, 1932. The species was noted in pools along the Reese River close to the Lincoln Highway on June 15, 1931, and June 22, 1933.

Notes made on May 29, 1932, at a pond where yellow-headed blackbirds nested in Smoky Valley represented coot behavior as observed often in the region. Two coots swimming in open water of the pond at 8:45 a.m. were preening and feeding on the surface. They were still feeding by 10:30. Apparently they were eating insects and plant material. The first kind of food was picked up mostly on the surface of the water. The second kind consisted of submerged plants which they got by reaching below the surface, sometimes the full length of the neck. A few times the bird would tip slightly. On another occasion when a coot was feeding and pulling up plants in deeper water, it would go down head first and back out of water, apparently just the reverse of the way it went down. The birds were swimming, at least with bodies floating, even where the water was shallow enough for them to stand. In 1 place the legs were used as poles for pushing rather than as oars for swimming.

Most of the time on that date the birds were close together, within 2 feet of one another. No sounds were heard from them. They appeared to pay no attention to any other birds, either small ones or the marsh hawks which flew over the pond many times. The coots seemed to be not aroused by alarm notes of blackbirds. Also they showed no indication that they were aware of my presence even though I was in full view all morning. On

previous days they always withdrew to cover when the pond was approached and stayed there until they were left alone. At 11 o'clock the coots moved over to the margin of the vegetation, but they soon came back out to open water where they remained after I left at 11:30. They did not appear to be frightened when I walked away.

On May 16, 1932, about 6 coots were watched in the morning on this pond. They were feeding among cattails, *Hippuris*, and sedges, and occasionally they came out into the open areas. After 8:30 they became rather quiet. Calls were heard at intervals, and, 3 or 4 times, one chased another for 30 feet across the open water. In late afternoon of May 26 one was seen on this pond with its head sticking up among *Hippuris* plants. It quickly jerked its head down out of sight when a marsh hawk gave alarm notes close by.

Although the birds seemed to be paired on this pond, they were prevented from nesting by the drying up of the water each season. The small extent of the available hiding places and feeding area may have contributed some to the failure to nest. I suspect that the species nests regularly in pools along the Reese River.

Oxyechus vociferus vociferus (Linnaeus)

Killdeer were noted most often in Smoky Valley, 5 mi. SE Millett and in the immediate vicinity of Millett. Other localities where this bird was noted are as follows: 12 mi. N Reese River R. S., several in alkali meadow east of road on June 22, 1931; Reese River at Lincoln Highway, two calling loudly on gravel bar near stream, June 15, 1931, one on road by bridge, silent, June 9, 1932; two in flight, June 22, 1933; Birch Creek, 7000 feet, heard on meadow, June 21, 1930; Kingston Creek, 6000 feet, 2 family groups, including young nearly full grown; 7 mi. N San Antonio, noted May 20, 1932.

Seasonally, all notes on this species were made between April 20 (1930) and September 9 (1931). However, it is certain that the birds were present in the region earlier and later than those dates. Holt (MS), in 1915, saw killdeer as early as March 19, in the southern part of the area.

Nests were found in 1915 by Holt (MS) on May 23 and 24, near Peavine Creek, and on June 2, 3, and 4, near Cloverdale Creek. Each nest contained a set of 4 eggs.

The habitat chosen by killdeer in Smoky Valley combined the features of visibility and freedom of movement over the ground and availability of moist ground or shallow water for feeding. That is, they lived on stretches of bare ground close to pools. The nature of the soil seemed to matter little. Sometimes it was dry and hard, sometimes wet and thickly covered with deposits of alkali, sometimes pure gravel.

Concern, when a particular area was approached, was exhibited by 2 killdeer on April 24, 1930. Earlier than this, pairs had been noted, but they had not been very demonstrative. On this date they stayed close to 1 spot, and at least one of the two called continuously. Two days later a pair of

killdeer was noted at the same place. The female was examined. The largest ovum was 13 mm. in diameter. Its mate stayed close to the spot, called a few times, and squatted on the ground.

On May 24, 1932, at 9:55 a.m. a killdeer nest was found SE Millett. It was 75 yards northwest of a small pond and on a raised area of nearly bare alkali ground, 40 by 20 feet, at the margin of a marshy area. Bushes of rose and rabbit brush grew within 50 feet.

When I had walked across the area half an hour earlier, both adults ran off and called a few times but not excitedly. After working around the pond, I started walking toward the place where I expected the nest to be. After about 10 steps I noticed a killdeer running off toward the northeast. It began calling when it had gone 30 feet. The nest was close to the spot where the bird first was seen running. I withdrew immediately back toward the pond. Ten minutes later (10:05) when I stood up within view of the site, the bird had returned and was close to the nest. It started to leave, but stopped when 5 feet distant and stood still until 10:12, when it turned and walked slowly to a spot near some dead brush that lay 4 feet from the nest. Here it squatted for about 10 minutes and then stood up. At 10:27, I again stood up and the bird started to leave in the same direction it had gone the first time, but stopped after going 2 feet.

The nest contained 4 eggs all pointing toward the center of the hollow. The structure was well built, for this species. It was a little larger in diameter than the distance across the eggs and was composed of sections of dead roots and stems of sedges such as covered the ground about it. Vision from the site was unobstructed except for the bushes and piece of brush mentioned above.

As the nest location was approached at 1 p.m. on the following day, a lone killdeer began calling at the pond. No bird was on the nest. Fifteen minutes later, from the pond, a bird was seen to leave the nest and start toward the northeast. As we moved no nearer, it stopped when it had gone 2 feet. At 2 o'clock it was still standing near the nest.

When the nest was approached at 8:30 a.m. on May 28, one bird was calling, and the other was running along the ground. After a wait of 5 minutes (Orr, the observer, was hidden), one of the pair started moving toward the nest, digging into the ground with its bill, and, apparently, feeding along the way. After going 2 or 3 feet it would stop and feed and after advancing about 15 feet, it would turn back for a short distance as if to disguise its actions. When within 30 feet of the nest, the bird began to run toward it with head held low. After one more stop it went to the nest and settled on the eggs, facing into the wind, that is, to the south. When the observer stood up, the brooding bird left, and both individuals started to call. Ten minutes later one of the two was back on the nest. When a slight noise was made, the bird turned its head quickly to look in that direction.

Later in the same morning, at 11 o'clock, the brooding bird slipped off the nest as soon as I came in sight. It moved about 3 feet toward the north, stood still for a minute or so, and moved out of view. When I stood up, the

bird was about 50 feet north of the nest, feeding on moist ground. Its mate was at the margin of the pond, and it began to call when I moved into the open. On June 7, the bird slipped off the nest and ran toward the west when I came into view, 75 yards away. It made no sound until I was within 2 feet of the nest, when it came to within 15 feet and called. Then it flew away. The next day, June 8, the young killdeer hatched. The following record of happenings that day was kept by Orr.

At 6:50 a.m. the first young one was breaking through the shell. The point of exit was at the large end and a little to one side of the egg. The first part of the bird to emerge was the right wing which was curled over the back. The back and neck were seen next and then the bill which was on the right side of the body. Next, the head and the 2 wings were freed from the shell. At this time the bird uttered a faint call distinctly killdeer-like. A call, a faint *seep*, had been heard when the shell was first broken. It answered squeaks, even before the head emerged from the shell. By 6:55 the young bird was upside down. It lay in that position, moving the feet to kick off the shell, and frequently calling, for 5 minutes, when it turned on its side. By 7:04 it had completely turned over, with its feet down, but the shell still partly covered the hind end of the body. The eyes were $\frac{1}{4}$ open when the head first appeared, but they were closed within a minute and remained so until the watcher left, at 7:12.

Four minutes later one of the parent killdeer came into view. It went directly to within 10 feet of the nest, stopped and turned around, and again went forward about a foot. This procedure was repeated several times, until the bird finally arrived at the nest. It sat on the nest, pointing its head away from the sun and partly spreading the wings. The bill was placed beneath the body several times, and then the bird settled itself. However, as soon as the observer made a move, the young bird left the nest and ran away for several feet.

By noon the 4 young had completely emerged, and they were huddled close together, one being on top of the others, about 6 inches from the nest. They were dry and had their eyes open but were unable to walk. Their heads rested on the ground most of the time. The parents stayed about 100 feet away and made no protest. The young were out in the hot sun. There was no evidence of any shells around or in the nest.

At 7:45 the following morning, June 9, when the nest site was visited, the young were not in sight. One of the adults flew up to within 25 feet of the intruder and called. After the latter had concealed himself and waited for 10 minutes, the bird slowly moved northward to a small pool about 75 yards from the nest. It went there in the same manner it had employed previously in going to the nest. It finally settled down. At 8 o'clock this place was examined and the young were found on the wet, cracking mud shore of the drying pond where there was a small amount of vegetation. They were sitting with their necks and heads stretched out along the ground. Their color matched closely the brown color of the moist earth. They were separated and about 2 feet apart. At first not a movement was seen on the part of them.

One of the young birds was picked up, and when it was placed on the ground, it gave a faint kildeer call and started to run away from the place where the parent was calling. The parent then came to within 20 feet, spread its tail, threw up its wings, and fluttered sideways, exposing its orange rump patch. The other parent could be heard in the distance, but it did not come within sight. Attempts to force the young one to go in the direction of its parent failed. It would attempt to climb over a person's hand rather than go in that direction. It called often but kept on running at a rate about equal to a moderately slow walk of a person. After this one had been brought back twice from a distance of 15 feet, the other young ones rose and moved in separate directions. The parent then became more excited, and its manner became more frenzied. The young one that had been handled ran 20 yards and then stumbled into a small depression where it remained. When the place was left, the parent followed the watcher, running and flying close, until he was 200 yards away. Then the other adult flew up and circled about, and both birds went back toward the nest. The young bird farthest away was just 74 yards from the nest.

A second nest of the kildeer in which the eggs were on the point of hatching was discovered on June 8, 1932 (Orr). A pair of adults was noted at 10:20 a.m. about a mile from the nest just described, which from their behavior were thought to have a nest. The nest was found after 20 minutes of watching from a concealed spot. At first both birds flew about and called. Gradually one of them moved off toward a dry pond, and the other slowly went along an alkali ridge. This one finally reached the nest. Several times, on the way, it stopped at small depressions and settled down as though upon a nest. Occasionally when on the move it would call; sometimes it would turn around and go back a way. Finally, it came to one spot where it settled down for 20 seconds, and then jumped up and walked about, calling for another minute. It went back to the same spot and settled down, calling even then. This proved to be the nest site. The shallow depression, 1 inch deep and about 4 inches in diameter contained 3 eggs. It was on slightly elevated ground where alkali was more conspicuous than the vegetation. There were some dry, dead leaves of *Cirsium* in the depression.

The 3 eggs each had small holes at the large end and $\frac{1}{4}$ inch to 1 side, where the bills of the emerging young could be seen. One young one that had completely emerged and was almost dry was found beneath a thistle leaf about 7 inches from the nest. When it was picked up and placed with the eggs, it uttered a faint series of notes somewhat resembling those of the adults. While being moved, it partly opened its eyes, but when put down, the eyes were closed and the head rested on the ground.

Two minutes later one of the young seemed to push apart the pieces of the shell and thrust out its right wing. At this time it made a few faint sounds. A slight noise made by the observer several times caused it to renew its efforts to emerge each time. One of the others, whose bill only was in sight, was heard to utter calls also. At 11 o'clock the young one nearest out of the shell had both wings and the head free. Like the others it was upside

down until it managed to turn itself by means of its wings. The shell still remained on the hind part of the body.

Capella delicata (Ord)

The Wilson snipe was found in spring migration seasons, at 5 mi. SE Millett; also present in small numbers through summer. One or 2 individuals seen on each day observed: April 20, 21, 27, and May 13, 1930. These birds were usually flushed from the small areas of marshy ground at the margins of springs.

Early in July, 1931, the winnowing notes of Wilson snipe were heard at evening in the wet meadow close to Millett, and the birds were seen in flight. Thus, it seems evident that the species nests in that neighborhood. However, no individual was noted from May 13 to June 9, 1932, when work was done about the valley. In the female, shot on May 13, 1930, the ova had just begun to enlarge.

Early in the morning of June 14, 1933, a Wilson snipe was seen perched on a fence post in the barnyard at Millett. During 15 minutes, at intervals of $\frac{1}{2}$ to 1 minute the bird gave a series of rapid, full notes which sounded like *cook*, repeated 7 or 8 times. For a part of the time the bird's bill was held over its back. Finally it flew over a willow thicket towards a pasture. The pasture was wet, covered with grass and sedges, and heavily cropped, but there remained considerable cover. This was the same place I heard the winnowing notes of snipe in the first week of July, 1931. Evidently it is a nesting locality.

Numenius americanus americanus Bechstein

The long-billed curlew was recorded in the area, on May 29, 1932, at 5 mi. SE Millett. The bird, a male, was heard calling in flight at noon on the east side of a large flooded meadow. It circled over a small pond and then lit on the dry ground 100 yards from the observer (Orr) and mid-way between the pond and the meadow. The bird made no sound while it was on the ground. Another individual was seen, May 30, 1933, in flight high over this pasture. In the fall, September 18, 1931, a small flock of long-billed curlews was seen at the reservoir, 7 mi. N San Antonio (Lamb).

Actitis macularia (Linnaeus)

At the reservoir 7 mi. N San Antonio, in Smoky Valley, several spotted sandpipers were noted about the shore in the evening of May 20, 1932. They were feeding at the same place early the next morning. One flew out over the water and suddenly dropped to the surface as if forced down by the wind, which was strong. On the same day at least 4 were seen along Peavine Creek near Peavine Creek ranch.

In the fall, 2 specimens were collected, a female at Birch Creek, 7000 feet, September 2, 1931, and a male 7 mi. N San Antonio, 5700 feet, September 18, 1931.

On June 1, 1933, a spotted sandpiper was seen feeding along the margin

of an irrigation ditch near South Twin River, 6300 feet. Single individuals or groups numbering up to four were seen about the ponds in Smoky Valley, 5 mi. SE Millett on May 18, 19, 20, 28 and 30, 1933.

Tringa solitaria cinnamomea (Brewster)

Two specimens of western solitary sandpiper, a male and female, were obtained on April 25, 1930, by Lamb, at 5 mi. SE Millett. Two individuals were observed on April 26 and 27, 1930, at the same place, and a single sandpiper thought to be of this species was seen on June 3. All the individuals seen were flushed from the margins of the small streams running below springs.

Actophorus semipalmatus inornatus (Brewster)

On September 17, 1931, Orr observed a single willet at the reservoir 7 mi. N San Antonio. Two more were seen the next day at the same place by Lamb.

Totanus melanoleucus Gmelin

The greater yellow-legs was found once in the fall, September 18, 1931, at the reservoir, 7 mi. N San Antonio, 5700 feet, where a single male was collected by Lamb.

Pisobia bairdii (Coues)

On August 20, 1932, 1 of 2 Baird sandpipers was obtained at the margin of a small alkali lake 3 mi. SE Rogers in Smoky Valley.

Pisobia minutilla (Vieillot)

A single female least sandpiper was shot September 8, 1931, at the margin of an open slough in a pasture 6 mi. SE Millett. It was the only shore bird seen on that occasion and was foraging in the short grass which grew up to the edge of the water.

Recurvirostra americana Gmelin

In Smoky Valley, avocets were numerous on August 20, 1932, feeding about the margin of and out in the shallow water of an alkali lake 3 mi. SE Rogers. Several came to meet me on my approach, and they gave loud notes of alarm. Others flew out over dry ground and gave alarm notes as I walked around the lake. A single avocet was seen, September 17, 1931, at the reservoir 7 mi. N San Antonio (Orr). A group of four was seen, May 30, 1933, feeding in a shallow pond, 6 mi. SE Millett (Compton).

Himantopus mexicanus (Müller)

Stilts were noted singly or in two's on May 20, 21, and 22, 1933, in Smoky Valley, 5 mi. SE Millett. They were in flight, high in the air or wading and feeding in shallow pools. On May 21 a stilt showed an unusual degree of tameness. When I stood on the shore of the pool where it waded and tried to drive it away the bird refused to leave but merely moved off to the opposite shore, 50 to 75 feet away.

Steganopus tricolor Vieillot

Present in the lower valleys through the summer, the Wilson phalarope was more numerous in migrations. A single specimen was taken, June 26, 1930, near Millett in Smoky Valley (Lamb). A lone individual was seen, June 3, 1930, wading in a shallow pool at this locality.

On May 13, 1930, 2 phalaropes were seen together feeding in a shallow pool, 6 mi. SE Millett, and another one was noted singly on another pool. At the ponds 1 mi. S of this location 6 individuals were noted on June 8, 1932. A part of the time these birds were flying about in high circles, singly and in two's, giving peculiar single, muffled notes which were rather loud for the size of the bird. Part of the time they were swimming near the edge of the pond, in water 6 to 10 inches deep. Most of the birds were females, although 1 or 2 males were seen. Nearly all of the ground for $\frac{1}{2}$ mile to a mile away on 3 sides of the ponds was flooded.

In the Reese River Valley, 12 mi. N Reese River R. S., on June 22, 1931, a phalarope flew overhead and protested by single notes as 2 persons walked across an alkali meadow. The bird was thought to have a nest near there.

On August 20, 1932, this species was numerous in a temporary lake, 3 mi. SE Rogers, in Smoky Valley. The birds were swimming and feeding in the lake. In 1933, Wilson phalaropes were seen in Smoky Valley, 5 mi. SE Millett, on May 19, 22, 28, and 29, and June 7 and 15. On the morning of May 29, a pair lit in a pond and swam about in the margin of a patch of *Hippuris*. The birds were sometimes in the open water and sometimes within the patch of plants. The female followed the male and uttered low notes. Once when the two were separated, the female flew about 20 feet to the male.

Lobipes lobatus (Linnaeus)

Apparently the northern phalarope was rather common as a transient. On May 17, 1933, one that had lost a wing was seen at a mud puddle in the road close to a spring at Millett. The bird was photographed, captured by hand, and released. The wound appeared to be fresh, but how it occurred was not determined. On May 22, a flock of 12 individuals was feeding on the surface of a pond 5 mi. SE Millett. Four of them were shot, 3 females and a male. One of the birds in nearly normal female plumage had in place of the normal ovary an organ which looked like a left testis. On the morning of May 23, 2 males and a female were seen feeding on the surface of another pond.

Larus delawarensis Ord

The ring-billed gull was definitely recorded once, May 21, 1932, when a male was shot at the reservoir 7 mi. N San Antonio, in Smoky Valley (Orr). The feet had a faint pinkish tinge in the freshly killed bird, and the eye ring was orange red. Another gull seen singly in flight near Millett on July 6, 1931, may have belonged to this species.

Chlidonias nigra surinamensis (Gmelin)

The black tern was an irregular straggler in the lower valleys in summer probably more common as a transient. At 5 mi. SE Millett a black tern was seen on the morning of May 28, 1932, flying over a flooded pasture. The bird moved close to the ground toward the south, into a strong south wind. In the middle of the next morning a lone individual flew over and close above the water of a pond where it stayed to feed for more than 5 minutes. Red-winged blackbirds near by gave alarm notes as though they were afraid of the tern. About 3 individuals were seen, August 20, 1932, in flight over an alkali lake, 3 mi. SE Rogers.

Zenaidura macroura marginella (Woodhouse)

Mourning doves were found commonly in the Toyabe region during the time of this study. They were most frequent in the lower valleys but occurred in the mountains regularly at least to 8000 feet. Individuals probably go higher than this but we found no example. The mourning dove season in this area was at least as long as our activity there. Earliest record was April 23, 1930; latest, September 10, 1931.

In general the situations inhabited by doves were spots where they could forage over bare ground, but where bushes or trees were conveniently near to provide screen and perching places above the ground. There was an apparent choice for habitats close to water, but the birds accommodated themselves to its scarcity by making frequent flights to it. All through the late spring doves were noted in small groups composed of from 3 to 6 individuals

A notion of the habitat of this bird in the area can best be conveyed by repeating extracts from our notes, as follows. April 24, a single bird on bare ground close to houses, just before noon, flew to bushes when disturbed; May 3, 3 perched on haystack in a feedlot in morning, 2 others feeding on bare ground at edge of alfalfa field; May 10, groups of 6, 2, and 1 single seen in fields especially where vegetation sparse; May 12, several in trees along stream in afternoon, sitting quietly in two's and four's in warm sunshine; May 15, 6 in a group, close together, feeding over nearly bare ground by corral at 6:30 a.m.; May 18, 2 flushed from alkali ground among willow, rose, and rabbit brush, in morning; May 19, at 1 p.m., 1 when disturbed took shelter close to ground in lower part of a buffalo-berry bush; May 21, at 8 a.m. one lit on rocky ground on a slope near a creek at 7800 feet where it walked a short distance and then flew on, sage, mountain mahogany and piñon were the surrounding plants; May 25, at 7 a.m., 2 flushed from dry ditch in center of big pasture; May 27, 1 perched in top of sage bush for several minutes, in afternoon 4 together among sage bushes near alfalfa field returned after leaving and fed on ground among sage; June 6, 1 perched on post in corral; June 20, 1 flushed from upper end of meadow at 7000 feet where ground was dry and open; June 21, 1 flushed from a piñon pine on a cliff; June 23, at 8000 feet, 1 flew from mud at edge of a spring in margin of aspens on a slope; August 31, one in morning on open slope just below a grove of aspens, flew to aspens when disturbed; September 8, several flushed

from ground among buffalo-berry bushes; September 10, 1 group in dried up bed of a pool where a thick stand of weeds was in seed.

Despite the almost daily recording of doves in lower parts of the area not a single nest was found. The total number present seemed to be much smaller than was expected from first inspection of the area. Evidently conditions here were not very favorable for this bird. I suspect that some unfavorable phase of the climate acted to limit numbers and breeding success of the species.

Cooing notes of doves were heard in 1930 as early as April 27. Near Kingston Creek, 7500 feet, one was heard cooing in midafternoon of July 1, 1931. It was on a ridge above the meadow. On May 27, 1933, cooing was heard several times in the morning as well as in the afternoon and evening, in Smoky Valley, 5 mi. SE Millett. In a group of 6 doves it was noticed that the pairs were segregated. The organization of the flock was obviously of 3 pairs.

In Smoky Valley, June 6, 1932, a dove was seen to fly at 3:25 p.m. from the ground to a corral fence. It left and returned in 10 minutes when it perched on top of a post and cooed 6 times, the interval between each 2 calls being about 15 or 20 seconds. While calling the head was lowered slightly, but kept in a vertical plane through the long axis of the body. Between calls the bird looked about and preened itself. In about 8 minutes another dove flew up and away from a spot on the ground 10 yards distant. Then 2 minutes later the one on the post flew away. Later one came to the same post and cooed 5 times, the interval increasing from about 15 seconds to 30 seconds toward the end. The bird then sat still, facing into the wind, for 12 minutes before it left.

Otus flammeolus (Kaup)

A female flammulated screech owl was obtained on South Twin River, 6500 feet, May 8, 1930. At 7:30 a.m. the owl was discovered, perched on the stem of a dead willow close to the stream. A junco had been shot from a perch within a foot below the owl when the latter was noticed. Its feathers were drawn up close to the body giving it a "slim" appearance. Ova were just beginning to grow. The stomach was nearly empty; weight of bird, 58.5 gm.

Bubo virginianus occidentalis Stone

Horned owls were heard at night close to almost every locality where observations were made in the Toyabe region. On the morning of May 19, 1932, one, flushed in Smoky Valley, near Millett, flew off $\frac{1}{4}$ mile and perched in a clump of buffalo berry where it was mobbed by 4 crows and a magpie.

Other types of resting place where owls were found varied from a limb near the trunk of a large aspen by the side of a creek, to large piñons in close-growing stands of that tree, and limber pine on the side of a ridge at 9200 feet.

The remains of 2 dead horned owls were found, 1 at the meadow near

Kingston R.S., on June 10, 1930, and the other near a deserted house, 5 mi. SE Millett.

On June 4, 1933, in Smoky Valley, 6 mi. SE Millett a nest was found that, judging from the feathers and pellets, had been occupied by a brood of young great horned owls. It was 10 feet above the ground in a small thicket of buffalo berry. Apparently it had been built by Swainson hawks. Five minutes later a great horned owl was flushed from a thicket 100 yards away and then another was found 150 feet farther away. In this thicket were 2 young owls out of a nest. These 4 birds were seen again on June 10 and June 16 (Compton).

Asio wilsonianus (Lesson)

The long-eared owl was a common species in the Toyabe region. Individuals were seen in trees and tall shrubs both in the mountains and on the floor of Smoky Valley but much more frequently in the latter location. The chief factor in determining the presence of large numbers of this bird seemed to be the large population of magpies. Almost invariably the nests of the owls were in old nests of magpies and numbers of the owls tended to vary in proportion to the number of available magpie nests. Doubtless the species could, and would, maintain itself in the region if no magpies were present, but it would be represented by much smaller numbers.

Most of the nests found were in tall bushes of buffalo berry. All of them were on the floor of Smoky Valley in a small area 5 mi. SE Millett. Height of the nest sites above the ground seemed to make no difference to the owls. Most of the occupied ones, however, were within reach of a person standing on the ground.

On April 21, 1930, an owl that was found on a nest was not driven away; it stayed even when I walked directly beneath the tree. When examined on June 3, this nest contained young in white down. The brooding adult left reluctantly as I approached, and it uttered anxious notes from near-by bushes. Another brooding owl was found on May 16, 1930. It remained on the nest until it was touched, and it then flew with a single low hiss. There were 5 eggs.

In 1933, more nesting pairs were found than in any previous season. On the afternoon of May 19, a nest was found which held 4 young owls about 6 inches in length and with wing feathers $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long. One parent was at the nest and another in a bush 15 feet away. The latter made a squeaking sound while a person was at the nest. When one of the young owls was removed from the nest, it snapped its beak, and immediately the adults appeared. They flew to the ground, uttered squeaking sounds, and acted as though crippled. When one of them was approached, it flew to a low, open limb and allowed its wings to hang loosely. Upon closer approach the owl regained its normal appearance and flew away.

Another nest found the same day held 3 small, downy young. Both parents were present, one at the nest and the other 6 feet away. While the

young were being removed from the nest, an adult was heard flopping about on the ground out of sight behind some tall bushes.

Another owl family was discovered on the same date. It occupied an old magpie nest in a ring of willows around a spring. Forty feet away a nest was occupied by magpies. The 4 young owls ranged in length from 130 to 160 mm. Their contour feathers were beginning to show. While a parent, perched near the nest, uttered alarm notes of 2 kinds, the other lit on the ground, fluttered its wings, and clicked its bill. On May 28, the largest young owl was about 8 inches long. It scrambled out of the nest when a person approached. All but the smallest one lowered their heads, spread their wings, and snapped their beaks when approached. Both parents flopped about on the ground. They continued to utter alarm notes for as long as a person was near, about half an hour. The young had left this nest by June 3, but evidently they remained in the vicinity for an adult close by showed considerable alarm.

A nest with 3 small young and a fourth just hatching was found on May 21, 1933. The brooding adult stayed on the nest almost until it was touched. It then went to the ground and flopped about as though injured.

Two downy young in a nest on May 22, 1933, were 1/3 grown and about equal in size. One stood up, fluffed out its down, spread its wings, clicked its bill, and lunged at a mirror that was placed near it. The other one remained quiet in the bottom of the nest. One parent was standing on the rim of the nest when it was found.

On this date a nest was found containing 2 eggs. The brooding adult flew away when a person came within 20 feet of it. Its mate was perched in another bush 8 feet away. Neither adult returned to the nest or showed much concern at being disturbed.

As a person approached 1 nest which held 4 young, the brooding adult behaved in a peculiar manner. When the intruder was 8 feet away, this bird rose and began fluttering and scrambling about the nest. After 45 seconds when he had advanced to within 4 feet, the bird crawled out of the nest and fluttered to a limb below and to one side. There the bird drooped its wings and continued to flutter them until the person was near enough to touch the nest. Then it flew to a higher limb, perched for a moment, and flew away. An adult perched 25 feet away and called protestingly while the nest was being examined. One of the young owls was very small and still in down; the others were nearly the same size and measured around 160 mm. in length. The large ones clicked their bills, but the small one made weak squeaks.

A nest examined on May 23, held 4 eggs that appeared to be fresh. The brooding bird, the only adult seen, made no commotion when disturbed.

A nest found on May 27 contained 5 large young more than half grown but still covered with gray down. Three of the young birds were standing on the rim of the nest, and a parent was perched close by when the nest was found. While the nest was being examined, the parent came close, clicked

its bill, and squealed, with quivering, spread wings, on the ground and in the bushes.

Most of the young owls seemed to be ready to leave their nests about June 1. At dusk on June 6, 1933, cries were heard in a buffalo-berry thicket $\frac{1}{4}$ mile from our camp, which sounded almost like the second part of a killdeer call. It was not quite so high-pitched as that note, but carried nearly as far. One observer named the maker of the sound as a killdeer at first. When I approached the thicket and made squeaking sounds, long-eared owls flew up from the places whence the sounds had come. One individual flew to within 20 feet of me and perched there for several minutes, constantly turning its head, first to watch me, and then to look in the opposite direction where there was another owl. From the appearance and behavior of these birds I judged this to be a family group and this was the first night the young had been away from the nest. (Two nests of young had been found in this thicket.) The notes differed from any that I had heard from this owl, and they were given almost continuously. This suggested that they serve as location notes which enable parents coming with food to find young ones which may have strayed too far to be seen readily in the dark.

On June 8, the call was heard again, but this time it seemed to be changed slightly. It was harsher and more drawn out than at first and sounded somewhat like the meow of a cat. I suppose that the same birds were heard, which seems probable. Similar location notes were heard after dark on June 9 and 10, and again on June 15. The last ones may have been from a brood just leaving the nest, for the sounds had not been heard for several days.

Three young owls, all able to fly, were seen with an adult on June 11, 1933. The young ones still had considerable down in their plumage. It was noticed that, when the adults flew, their feet were drawn up to the body, but the young flew with their feet hanging downward.

Several times long-eared owls were noticed hunting after dark. On such occasions they came repeatedly toward the source of squeaking sounds and would even hover directly over the spot whence such sounds had come.

Phalaenoptilus nuttallii nuttallii (Audubon)

Poor-wills were of widespread occurrence in the Toyabe area, but they were found in greatest numbers along the base of the mountains and on the meadows and ridges above the narrow cañons. Probably they merely avoided the narrow cañons so that they occurred evenly over the mountains rather than in 2 belts as our records seem to indicate. Seasonally, the presence of this bird spanned our season of observation. The earliest one recorded was seen on May 1, 1930, at South Twin River, 6500 feet. The latest was taken September 15, 1931 near San Antonio in Smoky Valley.

Opportunity to make any sort of record concerning numbers of this bird came so infrequently as to be of little worth. However, there is little doubt but that many more individuals were present than our observations show. For example, on 1 small area not much over 50 yards in extent 12 individuals were collected within the week ending June 24, 1930. Of course these were

feeding birds that had been attracted to an especially favorable forage site, but even so the number is large.

Without concentrated attention it is difficult to determine the exact daily period of activity of a poor-will. I had always assumed that it was a bird active at night, probably during all the hours of darkness. However, our records in the Toyabe region suggest that a much smaller segment of each day constitutes the period of activity, or at least of the major part of the activities. During June 1930, poor-wills called most actively in the first half hour after dark and, again, at daybreak. On June 20, several were heard on the slopes close to Birch Creek Meadow. After dark they flew down to the meadow. Two flew directly over our camp giving the "poor-will" call. All these birds became quiet soon after it became too dark to see to shoot bats. The next evening the first one was heard just after the first star was visible. The calls came from the vicinity of rock outcrops on top of a ridge. Later the birds came to the meadow to feed. Two were seen on bare ground at the margin of a seep at the edge of the meadow. On June 22, none was heard calling in the evening, but several were flying low close to the creek.

The stomachs of poor-wills shot in early evening were filled always with large insects. At Birch Creek Meadow where so many of these birds congregated in June, 1930, to forage, the stomachs examined contained large sphinx moths. One bird had two in its mouth. The moths fed in great numbers on the iris which grew in clumps about the moist ground, and the poor-wills gathered from the hills for the harvest. Here the feeding period each evening was remarkably short. At the same camp, around June 27, 1931, poor-wills were heard every evening in about as great numbers as on the previous year, but not in the same places. This time the irises had nearly finished blooming, and fewer moths were attracted than when they were in full flower. The poor-wills stayed on the rocky slopes and seemed to remain active later in the evening. Probably a longer time was required to get a meal than on the previous year. Foraging seemed to be most often close to the ground; 1 bird flew upward to a height of about 15 feet and hovered as if catching an insect.

Our observations revealed that the first concern of a poor-will when it became active in the evening was to feed. During the feeding time few calls were heard, but as soon as it was over the calls became almost a continuous series. Although sometimes uttered on the wing, they were most often given from a perch on or close to the ground. At the same locality, Kingston R. S., several individuals were seen, after dark, perched on the tops of fence posts at the margin of the meadow. Another favorite perching place here was the dry ground of a path which ran beneath and through clumps of willows on the margin of the meadow. On June 14, just after dark, an individual was seen to drop to the ground from among the branches of this willow clump. Whether it had been there for only a short time or for the whole day was not apparent. At Birch Creek Meadow the poor-wills usually lit on bare ground or on small rocks scattered over their feeding area. Roadways provided convenient means for searching out these resting birds since they tended to settle in the bare tracks. Here it was easy to locate them by the aid of a flashlight on account of the pink light reflected from their eyes.

Occasions when poor-wills were started from their daytime resting places were not frequent, but they were significant as indicators of where the daylight hours were spent. In Smoky Valley, in midafternoon of May 21, 1933, one was flushed from among the desert shrubs 5 mi. SE Millett. Near South Twin River, 6500 feet, at late dusk on May 8, 1930, a poor-will was flushed from a rocky place among sage bushes close to the stream. On September 6, 1931, one flushed on a rocky point on the west side of Bunker Hill, at 8500 feet. This was among mountain mahoganies just below limber pines.

A pile of feathers found June 14, 1933, beneath a bush 1 mi. S Millett gave basis for the notion that the usual daytime resting places on the ground do not provide absolute protection from capture by predators.

Some indications of the time of nesting were noted although no eggs were found. At Birch Creek, on the evening of June 20, 1930, 2 poor-wills flew near the camp, calling on the wing, which appeared to be one in pursuit of another. A female nearly ready to lay was shot, June 6, 1930, near Kingston R. S., 7500 feet. Another, examined on June 12, in the same vicinity, had ova just beginning to grow, the largest being about 3 mm. in diameter. A male, shot on May 27, 1930, on Wisconsin Creek, showed testes about 9 mm. in length, the right one being slightly larger than the left.

Chordeiles minor hesperis Grinnell

The Pacific nighthawk was a summer resident in the lower desert valleys; records of small numbers are rather frequent for Smoky Valley, especially toward the center and near the upper, western edge. Recorded once, June 18, 1931, in the mountains at Mohawk R. S. on the western slope. Earliest dates in spring are for 5 mi. SE Millett on June 3, 1930, May 30, 1932, and May 30, 1933. Arrival as late as this is distinctly an advantage to a bird which depends so completely upon catching insects in the air and at night or in colder parts of the day. Nighthawks contrast with the swallows in this respect since the latter forage more regularly in warmer parts of the day. Nighthawks were still present at Millett on August 18, 1932.

Usually nighthawks were noted in flight, often high in the air, sometimes in mid-day, but more often in early morning or late afternoon. Once, June 6, 1933, about 6 individuals were seen in flight close to the ground at 1 time over an open area and an adjacent moist pond basin, evidently attracted there by favorable forage conditions. Several times single birds foraged over the surfaces of ponds, sometimes touching the water. One bird on such an occasion was pursued by a male red-winged blackbird. Foraging nighthawks once were attacked by violet-green swallows.

Resting nighthawks were sometimes flushed in the daytime; one from a gravelly stream bed, another from alkali ground among clumps of rye grass and scattered groups of buffalo-berry bushes. Several times, nighthawks were found in the daytime resting on limbs of a large cottonwood at Millett. On July 5, 1931, one was perched all afternoon on a lower limb of this tree, 30 feet above the ground and 10 feet from the main trunk. People were standing and moving about beneath the tree for most of the afternoon. There was

a strong west wind. The bird's position was parallel with the limb and facing the west. On August 18, 1932, about 10 nighthawks were perched in this and adjacent trees. When shots were fired into the tree, the birds flew out, but they soon returned. Another was seen in this tree on June 22, 1933. Doubtless a position off the ground within the shade was of advantage in escaping intense heat which might have been encountered on the open desert, and it may be advantageous for nighthawks to avoid high temperatures.

Chaetura vauxi (Townsend)

A single Vaux swift was seen about 10 a.m., May 18, 1933, over a pond 5 mi. SE Millett. It moved off toward the north. Oberholser and Bailey (MS) saw 2 swifts May 31 to June 2, 1898, constantly about the house at Peavine Creek ranch near the southern end of the Toyabe Mountains. They concluded that the birds had settled for the breeding season.

Aëronautes saxatalis saxatalis (Woodhouse)

The white-throated swift was a summer resident and transient, over the valleys in migrations and when foraging, but restricted to mountains for nesting. Specimens were obtained at Birch Creek, 7000 feet, 2 females, June 21 and 23, 1930, and 5 mi. SE Millett, a male, June 2, 1930.

Scattered flocks of swifts evidently on their northward migration were noted on April 24, 25, and 28, 1930, in Smoky Valley, SE Millett. Numbers of birds in each flock varied from 15 or 20 to more than 50 birds. They flew either high in the air toward the north or close to the ground, in which case they stopped near buildings or over marshy ground and foraged, and then moved on toward the north.

Swifts which from their behavior were judged to come from nesting places in the mountains were seen foraging over the valley on several occasions in summer, as on May 12 and 17, and June 2, 1930, and June 7, 1932. On this latter date at least 5 were seen in late morning feeding over a small pond and adjacent marshes. Sometimes one would skim the surface of the water, stirring up ripples for 6 or 8 feet.

In the fall a flock of about 25 swifts was noted, September 2, 1931, flying about the large rock outcrop at the upper end of the meadow on Birch Creek, where a colony nested in summer. On September 9, a single bird was seen in flight over spring pools and brushland in Smoky Valley, 5 mi. SE Millett.

In the nesting season swifts occur at any place in the mountains, foraging over the sage-covered ridges, over the meadows, or over the cañons. Nesting sites were limited to crevices in vertical cliffs in cañon walls and to the sides of huge rock outcrops. Accessible forage ground appeared to be a factor favoring the choice of location, for the colonies were nearly always near a meadow or other especially favorable feeding place, and many miles of cliffs were left untenanted.

At the meadow, 7000 feet, on Birch Creek, a group of swifts was established for nesting each summer about the face of a huge rock outcrop at the

margin of the wet ground and more than $\frac{1}{2}$ mile from the nearest other cliff. On June 22, 1930, about 25 birds were watched as they flew about this rock in the morning. Mostly they kept about the top of the rock, 150 feet or so above the ground, and in a stratum higher than the swallows that were present. The loud notes most often were given when 1 bird flew near another, but they sometimes came from one flying alone. Many times, one flew rapidly after another until nearly to it, when the first would change its course and sail off. Once, in apparent aerial coition, 2 birds dropped 50 feet toward the ground, both with wings spread.

On the day before, June 21, at least 6 swifts were seen to enter, within 2 minutes, a crevice about 75 feet from the ground and 20 feet long. At one time 4 birds entered it at once. The crevice looked to be not more than $1\frac{1}{2}$ or 2 inches wide, but the birds went through the opening at nearly full speed, always swinging upward just before reaching the entrance. A single bird was seen to leave a small diagonal crevice in a pocket of the cliff 20 feet up. A nest was found there after removing a 2-inch deposit of droppings. It was composed of sticks lying parallel and running around the nest. These were glued together so as to form a flexible structure. A lining of feathers, possibly incomplete, was present, but no eggs (Miller). Another nesting crevice was noted 20 feet away, but it could not be reached.

On June 25, 1930, a mating pair of swifts was watched in the upper part of Birch Creek Cañon. They joined approximately 15 times within 5 minutes. The female (bird pursued) would turn over in the air and the male would catch up. Then the 2 pairs of spread wings served as sails to check the fall of the birds. Often the two spiralled, with the points of the wings outward. Sometimes the birds merely approached one another and then separated.

From the observations given above it is evident that eggs were not laid before the end of June, in 1930. Probably this bird is a late nester, regularly; it thus insures an adequate supply of insects for the young.

Calypte costae (Bourcier)

The Costa hummingbird is included here as a summer resident on the basis of an observation on June 19, 1930, of a male seen perched on top of a piñon in a narrow northside cañon off Kingston Cañon, at 7100 feet. The record was made by Miller who wrote of the bird as follows: "It rose in the air and performed a characteristic Costa flight—this being my chief basis for identification. The flight consisted of a long open swing, about 100 feet across with a high *tsee*—sustained through most of the arc."

Selasphorus platycercus platycercus (Swainson)

The broad-tailed hummingbird made up almost the entire hummingbird population of the Toyabe Mountains. At the same time, and in spite of its small size, it was one of the most conspicuous of the summer birds in that area. Beginning with our first work in the mountains, April 29, 1930, this bird was almost constantly within the field of our observation, both in activities along the streams and in flights out over the sage brush on the dry slopes and flats.

Evidently the long flights over the desert, which we heard the birds start and end, were for purposes of obtaining food. They always returned to the thickets and trees along the streams to rest and to engage in other activities. The streamsides, then, were the true homesites—forage trips only were made out over the sage. The direction of a flight could always be traced, even when the bird could not be seen, by the high-pitched buzzing whistle. This rattle of the wings was most characteristic, being far sharper than that of the rufous or Allen hummingbird. The sound seemed like an insect-made one.

Several incidental observations helped to show the nature of the feeding habits of this species. In the evening of May 10, 1930, just before dark, a hummingbird was disturbed from a cactus where there were about 8 large, bright red flowers, and where, presumably, the bird had been feeding. One collected on May 18, 1930, was hovering before a flower of the family Cruciferae. Another, on June 16, hovered at a rose blossom. One was seen at a bunch of *Castilleja* on a sage-covered slope, June 29, 1930, and others on June 2 and 5, 1932. During a light rain on the morning of June 2, 1932, a hummingbird was watched on a sage- and piñon-covered part of the floor of Wisconsin Creek valley. It was feeding at the flowers of larkspur, going from one plant to another.

A peculiarity in the summer distribution of this species was noticed in late May, 1933. Flowering of many plants was late that season, and during this half-month period bushes of *Ribes aureum* were in full flower in Smoky Valley. Almost every day several individuals of the broad-tailed hummingbird were seen perched in or near, and feeding at, these bushes. Apparently the birds remained there, held by the abundant food supply in the bushes, until the flowering season for this plant ended. At about that time they disappeared, presumably to go to summer homes in the mountains, 8 or 10 miles away. Here is an instance where favorable forage conditions evidently held a population in a habitat distinct from its normal one at that season. In other years when observations were made at the same location at the same season, not a single hummingbird was seen.

On June 18, 1930, at 7000 feet on Kingston Creek, a female broad-tailed hummingbird was watched which apparently was feeding upon flying insects caught in the air. It was in a small clearing near the creek. After a poise the bird would dart 3 feet after an insect, then poise and go after another. This was repeated half a dozen times, the bird being about 10 feet above the ground.

On May 27, 1932, along North Twin River at 6500 feet, a male was watched at its singing post on the dead stem of wild cherry, 6 feet up and 75 feet from the creek. It was at the lower margin of a rock pile at the base of a cliff. At intervals of 1 or 2 minutes the bird flew off up the cañon, making its buzzing sound, but it soon returned to the same bush. It perched on 2 or 3 different stems. Once it flew after and chased a warbling vireo from the vicinity of the bush. Besides the wild cherry, the thickets contained rose, buffalo berry, willow, birch, and cottonwood. Although it was separated from the stream by a road, the noise of the stream was loud at this point. How-

ever, the shrill noise made by the hummingbird could be heard above the roar of the water. This circumstance provided the basis for a possible explanation of the development of the loud character of this sound. Our observations indicated that the normal habitat for this species is close to mountain streams where there is usually much noise from running water. The situation thus would encourage the preservation and development of the loudest hummers, if the sounds made by the birds have some communicative significance to other birds. It seems probable that they do have some significance in hummingbird behavior.

A hummingbird was seen, June 19, 1930, near Kingston Creek, performing its nuptial flight. It rose about 60 feet and dropped in a nearly straight line, but made a broad U-shaped loop near the ground. No particular note accompanied the dive other than the almost continuous rattle of the wings. The dive was repeated 3 or 4 times in quick succession, the ascent being nearly as abrupt as the dive and following the dive without pause (Miller). I watched a similar performance on June 15, in the same vicinity. A few times here a hummer was seen in rapid pursuit of another.

A male broad-tailed hummingbird near Wisconsin Creek was watched for 2 or 3 minutes on June 2, 1932. It flew up in the air about 50 feet and poised. After a few seconds it dropped about a foot and poised again. After a total drop of about 10 feet, it flew up to near its original position. This happened 3 times before the bird flew away.

The following chronology of the behavior of a hummingbird watched on June 1, 1932, near Wisconsin Creek is of interest to show the manners of a male in the early part of the nesting season. At 1:50 p.m. it flew to the top of a wild cherry tree and perched for 2 minutes on a dead branch, uttering its screeching song several times. It flew across the cañon, but came back within a minute and perched at the same place, again singing 3 or 4 times. After half a minute it flew up into the air in a zigzag manner, making its buzzing noise, and dived downward to the same clump, disappearing for a few seconds. Another hummer was heard in the distance. The first one soon came to its perch again. It was quiet until a green-tailed towhee began calling, and then it uttered a series of distinct notes separated by equal periods of time. The hummer then remained perfectly silent, except for movements of the head, for 5 minutes. Then, there was a series of notes for $\frac{3}{4}$ minute, a red-tailed hawk appeared in the distance, another hummer was heard close by, and the notes became louder and more frequent. There was silence for a few seconds, after which the bird flew downslope for 75 feet to some cottonwoods near the creek, where it dived twice from a height of 30 feet, and then returned to its perch. Fifteen seconds later another hummer was heard near by. The one on the perch immediately flew in the direction of the visitor and the two, together, circled about the creek and cañon. Then they flew straight up in the air for nearly 100 feet and dived together. Next, they circled and dived again.

The 2 birds flew off and disappeared, being heard only a few times in the distance in the next several minutes. Then one returned to the perch in the wild cherry, sang several times and perched there for half a minute. After this

it responded to calls of another by notes of its own and by moving 2 feet higher and lighting again. It flew after another individual which came by; both returned, but only one perched. All was quiet for 3 minutes, when a second hummer approached, and the two flew down to the cottonwoods where they were quiet for 15 seconds. They then flew out again and moved around the area so fast that they could be followed only by sound. One returned to the perch with its tail spread fan-like and with an especially loud buzz (Orr).

Two hummers were watched in the morning of June 5, 1932, that were definitely distinguished as a male and female which were going through mating antics. At first both were in flight together. Then the male flew up into the air about 30 feet and made a U-shaped dive. Next, both birds flew up in the air for about 90 feet, one lower than the other by 4 or 5 feet, and they came down at the same time. One flew off to the side but returned immediately. Both flew up and repeated the dive. Then the male hovered for half a minute, over birches and cottonwoods along the stream, until the female disappeared. No noise was made by the male while hovering. It flew to a perch on the top of a dead tree where it remained for half a minute, until the strong wind caused it to move to a more protected perch 4 feet lower. Its wings were sometimes used to maintain a balance. It faced into the wind. No noise was made while perched or when descending to a lower perch, but when it flew straight away 5 minutes later, the buzzing sound was heard. It flew down-cañon and returned 4 minutes later.

Besides the responses to other kinds of birds, noted above, a male was seen on May 4, 1930, driving away a junco from the vicinity of its perch on a dead limb close to a creek.

Three nests of the broad-tailed hummingbird were found on June 21, 1933, along North Twin River. One was in a grove of aspens near a camp ground at 7800 feet. It was on a horizontal, leafless branch of an aspen 20 feet from the ground and halfway to the top of the tree. The site was 6 feet out from the main trunk, which was 10 inches in diameter, and on the upper side of the limb, where a side branch was given off. The female was bringing material to the nest which had been just started. This material was gathered from the trunks of trees at a distance up to 50 yards. Once when the bird could not dislodge the material from its bill, it reached up and pushed it off with its foot. The tree was surrounded by other aspens, on grass-covered ground, 100 feet from the stream. A male was heard in the vicinity.

Another nest, at 7000 feet, was 5 feet above the ground near the end of a broken branch of birch, which was drooping at a 45-degree angle near the periphery of the tree. The site was 20 feet from the stream and 10 feet from the trail. Cottonwoods and birches stood near by. The cañon-walls were steep. The female came and brooded the 2 eggs while I stood within 6 feet.

The third nest was 5 feet directly above the stream and a short distance below a 3-foot fall which made a loud roar. It was on a dead birch branch about half an inch in diameter which extended downward beneath a larger limb. The birch clump was 20 feet high, growing at the edge of the stream. Along the stream here were mainly willows and birches. The nest was well

shaded. The walls were not yet very high; they were plastered on the outside with whitish lichens and were more whitish than usual inside and out. The female came and brooded the 2 eggs while I was 6 feet from the nest. She faced the main limb of the tree.

On June 24, 1930, a female broad-tailed hummingbird was watched for an hour and a half in a grove of aspens at 7500 feet near Birch Creek. Between 8 and 9:30 a.m. it was about a nest 6 feet up in a crotch close to the top of a small, dead, leaning aspen overshadowed by larger trees. Not once did this bird produce the shrill whistle usually made by broad-tailed hummers although other individuals of that species flew by several times, always with the usual shrill noise. This bird flew to the nest and brooded on it for several minutes. After it left, the nest was examined and was found to be thin walled though it contained 1 egg. Later the female spent about half the time on the nest and the rest off, foraging in the near vicinity mostly for building materials. It returned from each trip with a billful. The cottony material brought was picked off the lower, dead limbs of aspen. It was picked off on the wing and, on each trip, from many places. When a good-sized ball of the fiber had been obtained, it was carried in the tip of the bill to the nest and added to the rim and inner side of the wall. Twice another hummer came near the nest and, each time, was joined by the brooding bird. However, their movements then were hidden from my view by the foliage.

Another nest found the next day on the same creek was on a chopped off stub of birch 5 feet above the ground at the margin of the stream. The female, brooding 2 eggs in the nest, flew off when I approached, but soon returned and settled on the nest while I stood with my face within 12 inches of the nest. It made no shrill sound in flight although it uttered vocally some sharp, squeaky notes. The nest was plated on the outside with thin pieces of outer birch bark, thus giving it the same color as the trunk of the tree. It was strongly saddled on top of the stub. When a piece of cotton was placed in the nest, the next day, the bird settled on it and tried to brood.

A nest containing 2 small young was found, June 2, 1932, along Wisconsin Creek at about 7000 feet. The site was in a birch, 10 feet up, and directly over the water of the stream. It was on a nearly horizontal dead limb about half an inch in diameter and on the lower side of a main birch stem, leaning at a 45-degree angle. The nest was 8 inches from the main stem and directly below it. I first noticed the female poising nervously within 20 feet of the nest as I stood 12 feet from it. When I retreated a short distance, the female returned, perched on the rim of the nest and fed a young one, pointing the bill straight downward. The parent then settled on the nest, facing the main trunk, and remained there until I left. This female was seen on the nest several times in the next 3 days.

On June 5 the female was on the nest from 8:45 a.m. until 9 when it was absent. It was not seen until 9:07 when it was hovering over and perching on dead twigs within 20 feet of the nest. After 3 minutes of this the bird perched on the rim of the nest and fed the young.

At 10 o'clock I saw the female go to the nest and feed 5 times, the last for only a short period, and then brood. The first thrust was deep down the gullet of the young, and then the bill was withdrawn gradually. At 10:12 the female was off the nest. At 10:19 it returned and fed 4 times and brooded. Each feeding required between 5 and 10 seconds. It was not more than a minute from the time of arrival to time of settling on the nest. The bird faced at least 3 directions while brooding but always stood on the north rim to feed. When it left at 10:27, there were clouds and a cold wind. At 10:31 it returned directly to the nest and began to brood.

Stellula calliope (Gould)

Two males collected on June 21 and 24, 1930, at Birch Creek, 7000 feet (Lamb), indicate that the calliope hummingbird is a summer resident in the Toyabe Mountains. Absence of other records, however, shows it must be present in only limited numbers. One of the birds was perched on a protruding dead snag among a clump of willows in a small cañon near a large meadow. The other was in the top of a dead willow in the meadow.

Megaceryle alcyon caurina (Grinnell)

Three belted kingfishers were seen; all of them, possibly, transients. At Birch Creek, 7000 feet, a kingfisher, watched at noon on August 30, 1931, flew over the meadow and down the creek into the cañon; a call was heard once. The second one on May 16, 1932, flew silently to a pond, 4 mi. SE Millett, where it took something from the water and left (Orr). In the morning of May 21, 1932, the third one was heard along Peavine Creek near Peavine Creek Ranch.

Colaptes cafer collaris Vigors

The flicker proved to be the most widespread and most numerous woodpecker in the Toyabe region. Even so, not many individuals ever were seen in one day. Throughout the area this bird lived wherever there were trees of any sort. Kinds of trees which it frequented were buffalo berry, cottonwood, aspen, piñon, limber pine, mountain mahogany. Nesting holes were found all the way from the lowest point in the valleys to the highest trees in the mountains. Flickers extended their activities beyond the trees, for many times they were seen foraging on the ground among sage and other bushes.

The night quarters of a flicker were discovered on April 27, 1930, in Smoky Valley, 5 mi. SE Millett. Just before dark a tin shed was being examined when a flicker that had settled to roost there flew out and lit on a near-by post. It then flew away.

Instances of the association of this species with other birds were noted infrequently. Once, on May 27, 1930, a flicker was seen perched in a dead mountain mahogany along with Clark nutcrackers. On Birch Creek meadow where there was a deserted house, mountain bluebirds were nesting in the wall, in a cavity that had been made originally by flickers. Twice in one day the bluebirds actively drove away a flicker which happened to come near.

Judging from the extreme wildness of the flickers here and the small total numbers, it was concluded that they were subjected to capture by hawks. Probably Cooper hawks and prairie falcons were ready to capture any flicker which exposed itself freely.

Observations at one nest of flickers began at 8:30 a.m. on May 24, 1930. At 8100 feet along Wisconsin Creek, a flicker flew rapidly down the mountainside, through a group of aspens and to the trunk of one, but on the opposite side from where I stood. Ten minutes later when I walked to the tree, the bird withdrew into a cavity 5 feet above the ground and would not leave, even though I pounded the trunk. There were fresh chips on the ground. At about the same time the following morning the rolling call of a flicker was heard near this site. The nest cavity was at least 65 cm. deep. The entrance was 65 mm. in horizontal diameter by 70 mm. vertically. From the outside lower lip of the entrance to the back of the cavity horizontally was 16.5 cm. The entrance was an old hole at the lower end of a dead stub. It had been used previously but was dug deeper this season. On May 27 when a stick was poked into the cavity, there was no response by the bird although it could be felt with the twig. After I had moved off and waited 3 or 4 minutes, the bird flew off quietly to a group of trees 30 yards away.

On June 8, 1933, an occupied nesting hole was seen 20 feet up in a stub of a living cottonwood close to South Twin River at 6700 feet. The cavity was a new one a foot below the top of the stub. The ground was littered evenly for about 10 feet on the north side with new chips. When the base of the tree was hit, a female stuck its head out of the cavity and flew away.

Close to Big Creek a nest was found on June 24, 1931, 4 feet above the ground in the hollow trunk of an aspen. The cavity was a natural one below a crotch—possibly it had been dug out slightly by the birds. Its inner diameter was 7 or 8 inches; its depth, about 18 inches. Inside were 7 young all nearly fully feathered and calling for food. One of them was clinging at the entrance when I approached, but it withdrew to the bottom of the cavity. The hoarse, low-toned chatter of all the young combined sounded much like the roar of a swarm of bees, but the sound was coarser. The two young ones taken from the nest did not strike at my hand with their bills, but they clung tightly with their claws to whatever objects were within reach—a small rock or a finger, for example. The parents in the vicinity, although within hearing of the sounds made by the nestlings, kept at a distance of 25 or 30 yards and gave only 1 or 2 calls.

Asyndesmus lewis Gray

On the morning of May 16, 1930, a Lewis woodpecker perched momentarily on top of a post, 6 mi. SE Millett; it then flew on silently toward the east.

Dryobates villosus orius Oberholser

Relatively few hairy woodpeckers were found in the Toyabe region. These occurred wherever there were trees in the mountain range. Foraging birds were noted in piñons, limber pines, aspens, mountain mahoganies, and cottonwoods. They were most numerous, however, in the stands of aspens between

altitudes of 8000 and 9000 feet. Usually this woodpecker was seen on or close to dead trunks or limbs of trees.

On June 17, 1931, on Mohawk Creek a pair of hairy woodpeckers showed special concern at a new nest hole 9 feet up on the south side of a dead aspen. The male carried a billful of food. Young birds could be heard calling, but not loudly. Another nest in a dead aspen in the vicinity contained young.

An occupied nesting hole was discovered, June 8, 1933, 35 feet above the ground in the tallest live cottonwood near South Twin River at 6700 feet. When the trunk of the tree was hit with a stick, a woodpecker flew out and uttered notes of alarm.

Tyrannus verticalis Say

The Arkansas kingbird was a common summer resident in the lower valleys of the Toyabe area. Nesting pairs showed a marked preference for locations near occupied buildings. At least the birds were seen earlier about the buildings on the larger ranches than at some isolated deserted buildings where they nested. Greater availability of food seemed to be a factor accounting for this choice. Late arrivals, then, were forced to take up less favorable locations. Transient individuals were less closely restricted as to surroundings and were seen away from regular nesting sites. They were seen most often foraging over fields or over moist ground or ponds.

In 1930 the earliest kingbirds were heard on April 28 in the trees around the buildings at Millett. The next one seen was taken on May 8 and another was found on May 10 near South Twin River at 6000 feet. Two more were seen near here on May 12. The first one to be recorded 5 mi. SE Millett was seen on May 13. The earliest record here in 1932 was on May 15; in 1934, the first was seen on May 19. The only fall record is of a female taken on August 31, 1931, at 7000 feet on Birch Creek.

This species nested in at least one place in the mountains, at Austin. Here again the attracting influence seemed to be the presence of civilization, acting through the food supply. On the morning of June 16, 1931, this was the loudest participant in the early chorus of bird notes.

Each summer a pair of Arkansas kingbirds nested about the corral at the deserted ranch buildings 5 mi. SE Millett. Usually the nest was placed on a horizontal stick between two of the upright poles. In 1930, the nest was well-started on June 3. On June 26 it held 4 heavily incubated eggs. Both birds of the pair protested loudly when a person came near the site.

In 1932 a pair of kingbirds was noted at this site first on May 31. In the evening these 2 birds chased away 2 others which came near the nesting site. The latter flew on toward the north. Although these birds remained in the vicinity, actual nest building was not seen until the afternoon of June 6. At 2:30 p.m. when 8 cowbirds came and perched about the corral, the kingbirds flew at them with threatening calls several times and then flew off for 30 yards, calling from that point until the intruders left. Then the kingbirds flew back to the corral, one of them carrying nesting material. When the

birds left at 4:03, this spot was examined, and some string was found on a crossbar between two posts. At 4:30 the birds returned, each carrying a piece of string in its claws. One bird perched sideways at the nest site and arranged the material. The string was taken from the feet by the bill. The second bird twittered as it perched near by.

Sometimes one or both members hovered over or near the site. It could not be determined whether both participated in building. The one that arranged the material flew to the ground within 15 feet of the post a number of times and picked up feathers which it placed on the nest. The strong wind, however, usually blew these away in a moment. Sometimes the bird would fly after them, sometimes not. When coming to the nest or hovering over it, the birds uttered a peculiar, high-pitched series of quavering notes. Twice one of them brought branches of *Sarcobatus*, 5 or 6 inches long. These it was able to keep at the site. When manipulating the nesting material, the bird would scrutinize the area a number of times and then use the bill, or sometimes the feet, to move the string and sticks. At 5:05 the birds flew away, but they were seen again at 5:45.

In the afternoon of June 7, 2 kingbirds were perched near the nest at 5:15. A third one arrived, there was much chattering, and all three flew off toward the north. Two of them returned within half a minute. After entering a shed in the vicinity, these two came out and flew off toward the south.

The kingbirds were seen about their nest several times on June 8. By this time the base was well established. The lower part was composed mainly of string of various sizes, mostly white in color. Some pieces hung down for about a foot below the nest. Above this was an equal amount of sticks mostly the dead flowering stems of *Chrysothamnus*. These evidently were obtained by the birds on their long trips. Usually both birds stayed close together either at the nest or on trips. At this time almost as many sticks lay on the ground where they had fallen from the nest as were in the proper place.

Once in the afternoon when a shrike perched on a buffalo-berry bush in the neighborhood, a kingbird flew there with alarm notes. When the shrike dropped to a lower perch, the kingbird settled on top of the bush and stayed until the intruder left. The kingbird then followed in pursuit and uttered calls. Early in the morning of June 9, one of the kingbirds flew 100 yards from the nest and pursued a marsh hawk for about 100 yards. This one was evidently the male for it was the one which followed on trips for material and, at the nest, it perched on a near-by post while its mate did the building. No observations were made in 1932 after this date.

Observations were made on nesting kingbirds at this corral in 1933. Four individuals (2 pairs) were perched on the fence in the evening of May 23; all these flew away toward the north. Two birds were seen here on May 27, 3 on May 29, and 2 on May 30. In the afternoon of June 1 a single bird was working at the beginnings of a nest at the corral. There was a strong wind. Two other kingbirds flew over, this one joined them, and all three flew toward the east. At the nest site there were only a few sticks. Two birds

were present at the corral at 6 a.m. on June 3. One was working at the nest which, despite the strong wind after the time it was started, had a well-formed base. By June 4, the nest was nearly completed. The bird was especially active in early morning before the wind became strong. Although 2 birds were present, apparently only one actually carried materials.

On June 7, at 5 a.m., one bird was at work at the nest. The other one was chattering, perched on a fence close by. The nest appeared not much different from the day before. Laying began on June 8, for a bird was on the nest early in the morning, and there was 1 egg in the evening. At 5 a.m. on June 9, the bird was on the nest; there were 2 eggs an hour later. No bird was there at noon. The next day at 6 a.m. there were still 2 eggs; and the bird was at the nest. At 1 p.m. the bird was brooding 3 eggs; it was noted on the nest at 2:30 p.m. Incubation evidently started with the laying of the third egg. The nest held 4 eggs at 2 p.m. on June 11. The eggs were still being incubated when this nest was last examined, on June 22.

A nest-building pair of kingbirds was watched on the morning of June 7, 1933, near Rogers ranch. The nest was on top of a broken telephone pole stub. Two boards nailed on opposite sides of the stub provided protection for the nest and support for the wire overhead. There had been difficulty in making the material stay in place, for there was a considerable amount of it on the ground at the base of the post. During 20 minutes the birds were watched, one was perched on the wire above the nest, and the other brought and placed all of the material. When the observer walked up to examine the nest, both birds began to scold, and a third one appeared from the direction of the ranch buildings.

An apparent reason for the material not staying in place was that the bird did not get it onto the support before trying to form the nest. It repeatedly brought a single straw and then did a lot of flopping as if to form a cup, with the result that much of the material was forced to fall to the ground. By June 11 the nest evidently was completed, but it was still empty. A kingbird on the wire above the nest left without protest when approached.

On a visit to Millett on June 14, 1933, 4 nests of this kingbird were found within a short distance of the ranch buildings. One was in a crotch of a post in a small pasture near the house. Its rim was 5 feet above the ground. Inside diameter at the rim was 8 cm. Depth of the nest outside was 18 cm. Greatest width, outside, was 25 cm. Chief materials in the nest were weed and grass stems, wool, and rabbit fur. The lining contained some twine and horsehair. The site was not shaded. In the nest 3 eggs evidently constituted an incomplete set. Both adults stayed near by.

Another nest, $4\frac{1}{2}$ feet up on a pole in a corral, with inside diameter at the rim 8 cm. and outside depth 10 cm., was much smaller than the last one, the outside diameter of which was 15 cm. Also the material was finer than in the last nest. The lining was of wool and horsehair. Five eggs constituted the set. Both adults protested at disturbance.

A third nest was 10 feet up in an old apple tree surrounded by pasture. The site was where 2 nearly horizontal limbs crossed. The rim inside was

8 cm. across. Outside it was 20 by 15 cm. The nest was 10 cm. deep and was made of sticks, strips of cloth, string, and wool. It was lined with wool and black horsehair. Both adults protested vigorously at my close approach. There was only 1 egg in the nest.

The fourth nest was not yet complete and was empty. It was between 2 posts in a fence and was supported by barbed wire which tied the posts together. The nest rim was a little under 5 feet above the ground.

On June 22 the nest in the forked post contained 4 eggs. The one on the corral had 4 eggs and 1 young bird just hatched. It was covered with white down. The parents here showed more concern at our close approach to the nest than did any of the others. The nest in the apple tree had been torn down, evidently by persons. The one between 2 posts was still empty and apparently abandoned.

Myiarchus cinerascens cinerascens (Lawrence)

The one ash-throated flycatcher observed in spring was evidently a transient. It appeared about the buildings of an abandoned ranch, 5 mi. SE Millett, on May 26, 1932. It was near the headquarters of a lone Say phoebe (probably a male) and apparently had been attracted there by the cries of the latter bird. The ash-throated flycatcher proved to be a female, weight 27.5 gm.

Three individuals, probably all young of the year, were noted, August 16, 1932, in sage and willows at 6700 feet on Big Creek, at the western base of the mountains. A female and male were collected.

Sayornis saya saya (Bonaparte)

The Say phoebe was a summer resident found in small numbers but scattered widely over the Toyabe area especially in the lower valleys and on the lower slopes of the mountains up to 7000 feet. The bird was surely present seasonally beyond the limits of our work in the region. Extreme dates in our records are April 20, 1930, and September 11, 1930, both in Smoky Valley, 5 mi. SE Millett.

During the migrations fairly large numbers of Say phoebe were seen usually resting on fences or bushes. In the fall they were seen making flights toward the south evidently as part of the migration carried on in the daytime. At these seasons this species obviously was not restricted to such narrow habitat limitations as in the nesting season in summer.

In summer the homes of Say phoebes were found about such places as buildings, often deserted by their former human occupants, bridges, and open mine shafts.

In the mountains a nest was found, June 20, 1930, at the meadow on Birch Creek, 7000 feet. It was on the top of a log beam beneath the thatched roof of a shed and 6 feet above the ground. The nest contained large, partly feathered young. The parents perched on near-by poles and made flights over the meadow for insects. After dark on June 21, one parent was perched

on the rim of the nest; the other one could not be found. By June 26, the young were nearly fully feathered and ready to leave the nest.

Near South Twin River, 6500 feet, on April 29, 1930, a nest was found near the entrance of an old deserted mining tunnel. The site was a little over 4 feet above the floor of the shaft. It contained 2 eggs, judged to be an incomplete set because no adult was seen near there.

On the Lincoln highway a bridge across Reese River furnished a nest site on one of its supporting beams. The nest found here on June 22, 1933, contained 3 small young with dark-colored down and 1 unhatched egg. Both parent birds came near and called in protest at our presence.

The station in Smoky Valley, 5 mi. SE Millett, supplied a series of observations on Say phoebes extending over parts of 3 nesting seasons. On April 20, 1930, when the first visit to that place began, a single individual perched for most of the day about the buildings and fences. On April 22, we saw traces of a nest on a sill in a tin building, and a phoebe came near, uttering notes of alarm, when the site was approached. On the evening of April 27, the nest was about 2 inches high. On April 28, a lining could be seen in the nest. By May 13, this nest was still empty, but its rim was higher than it had been 2 weeks previously. During a rainstorm at noon on May 15, a search was made for the birds without finding them in the shed. By May 17, there were 2 eggs, and on June 3 there were 5. At 2 p.m. on the latter date no bird was seen when the nest was visited.

When this locality was visited next, on June 26, a phoebe came about the adobe house in the afternoon and gave excited calls. On top of the log ridge-pole of this building a newly built but empty nest was not quite completed. At the site of the nest observed on former visits, in the tin shed 100 yards away, no sign of a phoebe could be seen. It seemed probable that the pair was nesting for a second time, and that they had transported the nest material from the old site to the new one. It seemed unlikely that any other animal had gone beneath the roof to tear out the nest.

In the 1932 nesting season observations were made at this same locality between May 15 and June 9. Almost every morning during late May a single phoebe was heard calling near this shed. It would be heard during the first 2 or 3 hours of daylight but not again during the day. Usually it perched on the top of a tall post near the shed. Sometimes it flew to the other buildings, but it did not stay for long. All the observations contributed to the conclusion that this was probably a lone male trying to attract a mate. Each morning the notes (song) would be given almost continually.

On May 26, at 8 a.m., 2 phoebes were present; this was the first time more than one had been seen. One of them was singing excitedly, and it entered the shed twice. The other one, apparently the new arrival, was quiet, and it soon took flight toward the southeast. After it had gone out of my sight, the other bird followed giving continuous calls and beating its wings rapidly. At noon a Say phoebe was back at the shed, this time with an ash-throated flycatcher. The latter was the only one of its species ever to be seen in this vicinity. It seemed obvious that it had been attracted by the notes of the phoebe.

On May 29, the lone phoebe was calling inside the shed at 7 a.m. Several times it flew from the ground to the site of the 1930 nest, as if it were carrying material. A phoebe was seen about the shed at 3 p.m., and on the beam where the trip had been made, a low heap of material stretched over about 4 feet of surface. This had not been noticed previously. The bird continued to hold the nesting site alone. It was seen last on June 9, when the nesting material looked unchanged. The phoebe, however, was not calling so excitedly nor so persistently as it had 2 weeks previously. Two individuals were seen on the morning of May 31, but one of them flew away.

The next visit to this place was made on August 19, 1932, and, as earlier in the summer, a single phoebe was present at the buildings. When shot and examined, it proved to be an adult male, possibly the same bird that had been watched in May. If so, it apparently had failed in its efforts, so obvious to the human watcher, to attract and hold a mate. Thus, a perfectly good unit of nesting habitat (territory) for Say phoebe produced no young in the 1932 season.

In 1933, a single phoebe was seen at the site on May 18 and 20, but on the morning of May 21, 2 birds were noted. One was seen on May 19 picking materials from the ground and dropping them again. At 3 p.m. on May 22 a phoebe was carrying nesting material to the shed from a spot on the ground about 100 yards eastward from the site.

No effort was made to follow the history of this nest in detail, but the fragmentary notes made serve to show interesting points in its story. At 1:30 p.m. on May 23 one of the birds made 2 trips within a few minutes to gather nesting material. On the second trip it tested 12 or more objects before suitable ones were selected. More than 1 piece was carried on 1 trip. The bird tried to tear shreds from a dead weed stalk and failed. It then tried to tear and carry an 18-inch strip of cloth, but that too failed.

On May 24, a phoebe was gathering nesting material at 12:50 p.m. In the shed it was noticed that the material was being piled in 2 places, between adjacent pairs of rafters. Apparently the birds were unable to distinguish the exact locations, and they were building bases for 2 nests. The next day at 3:25 p.m. a bird was carrying cotton to the site. On May 26, 1 nest was more than half completed, another was about $\frac{1}{4}$ its full size.

On the afternoon of May 29, an egg was found in the main nest, the one that had received the most attention from the birds. The next day it was noticed that there were 3 distinct cups in the mass of nesting material, and there was 1 egg in each of the 2 northern ones. On June 1, all 3 cups contained eggs, two in the central one, and one each in the 2 end ones. A bird was incubating on the central cup on June 2, 7, 10 and 15. On the 10th the central cup contained 3 eggs. By June 22, the eggs had not hatched, and evidently they had been abandoned. However, the birds were near by; they were seen mating on a fence 40 feet from the nest. We were unable to find any other nest.

Presumably one bird of this pair stayed on the nest during the night. A clue as to the night roosting place of its mate was obtained on June 11. At

7:30 p.m. one of the phoebes flew to and entered an empty shed 75 feet from the one which contained the nest. It remained there, evidently to spend the night. This had been noted at least once previously.

Empidonax traillii brewsteri Oberholser

Oberholser (1918, p. 93) obtained the type specimen of western Traill flycatcher on May 31, 1898, at Cloverdale. Specimens in Mus. Vert. Zool. were taken in the fall. A female was obtained, August 16, 1932, on Big Creek, 6700 feet. In Smoky Valley, 5 mi. SE Millett, 5 specimens were collected from September 8 to 11, 1931.

Toward the end of May, 1932, several flycatchers among the willow thickets in Smoky Valley were identified as belonging to this species. On May 29 one was seen at the margin of a pond, perched within 2 feet of the ground on willow stems. It stayed beneath the main part of the foliage in a willow clump on the north side of the pond and fed by making short flights over the water. For most of the morning this individual remained within 30 feet of where it was first seen.

On June 1, 1933, a pair was found in a willow-rose thicket along South Twin River at 6000 feet. On that day a strong wind was blowing, and the birds kept close to the ground. Apparently this was a pair established for nesting, but careful search on subsequent days failed to reveal the presence of these or other individuals. Thus, while it seems probable that the Traill flycatchers nest in willow patches in both Smoky and Reese River valleys, there is as yet no definite proof that they do. However, insufficient effort was made to find them.

Empidonax hammondii (Xantus)

Hammond flycatcher is a transient, most numerous in the fall. Two males and 3 females from Birch Creek, 7000 and 7500 feet, were taken August 29 and 31, and September 2, 1931. A male and 2 females were taken on Kingston Creek, 6000, 7000, and 8000 feet, on September 4 and 5, 1931. A male (U.S.N.M., no. 158364) was obtained, June 1, 1898, on Peavine Creek at the south end of the Toyabe range.

Empidonax griseus Brewster

Gray flycatchers were common in migrations, but no positive proof was obtained that the species nests in the Toyabe area. Two specimens in U.S. N.M., one (no. 158350) from Arc Dome, May 25, 1898, and one (no. 158354) from Cloverdale, May 30, 1898, give basis for supposing that this bird nests in the Toyabes. Our work produced specimens, as follows: Birch Creek, 7000 feet, August 29 to September 3, 1931; Kingston Creek, 6000 feet, September 4, 1931; 5 mi. SE Millett, Smoky Valley, April 26, May 13, and 17, 1930, September 9 and 11, 1931; South Twin River, 6500 feet, April 29, May 1, 5, and 6, 1930.

Empidonax wrightii Baird

The Wright flycatcher proved to be the most common member of its family in the Toyabe Mountains. It was found at every locality where obser-

variations were made. In the lower valleys it was transient, but in the mountains it was a common nester. Specimens were obtained in Smoky Valley, 5 mi. SE Millett, on May 13 and 17, 1930, and September 9 and 11, 1931. Specimens were preserved from the following localities in the mountains: Big Creek, 8000 feet, August 15, 1932; Birch Creek, June 21 to 25, 1930; August 29 to September 2, 1931; Kingston Creek, several dates in June, 1930, August 17, 1932, September 4 and 5, 1931; Mohawk Cañon, June 19, 1931; Wisconsin Creek, May 27 to 20, 1930; Ophir Creek, 8000 feet, May 30, 1930; South Twin River, 6500 feet, May 12, 1930.

Wright flycatchers were present in large numbers through most of the mountains. The small size and scattered arrangement of most of the trees seemed to provide just the sort of habitat required by this bird. It lived both on the ridges and near the streams and in all the kinds of trees and tall bushes, even out in nearly pure stands of sage brush. The mountain mahogany was probably the plant best suited to the needs of this species in the region.

Intolerance on the part of this flycatcher toward other small birds in its nesting habitat was noted on June 23, 1930, near Birch Creek when one repeatedly flew at a house wren in an effort to drive the latter out of a birch. The flycatcher also flew at another bird, not distinctly seen but thought to be a green-tailed towhee.

On a ridge at 9000 feet, south of Kingston Creek, on June 14, 1930, a Wright flycatcher was seen carrying nesting material through an area of second growth, scrubby limber pines on a steep slope.

Two nests were found in North Twin River cañon. One, discovered on June 20, 1933, was in a partly dead clump of willows in a grove of aspens. It was in a 3-way crotch, about 10 feet above the ground. An adult was brooding upon 3 eggs at 7:30 a.m. At 3 p.m., it was again on the nest. An egg on the bare ground near by in a trail was obviously laid in the interval between the visits. Doubtless it would have been the last egg of the set. Apparently this was the day of the start of incubation.

A second nest was found the following day in the same cañon. This one was 5 feet up in a 15-foot willow in a clump of willow and wild cherry at the edge of an aspen grove at the lower end of a meadow near 8000 feet. A bird was seen carrying nesting material near this nest. The rim inside measured 55 mm.; depth outside was 90 mm. Two grouse feathers showed in the lining.

Another nest, found June 25, 1930, in a mountain mahogany tree near Birch Creek, 7000 feet, was saddled on a horizontal limb where 2 small twigs grew out perpendicularly 7 feet from the ground. The tree was on the side of a ridge 30 yards from a birch-lined creek in a cañon. The 4 eggs were just on the point of hatching (Lamb).

Ridgway (1877, p. 541) found more Wright flycatchers near Austin than at any other locality in Nevada. He found 5 nests with eggs there on July 3 1868. On 2 nests he caught the brooding females in his hands.

Empidonax difficilis difficilis Baird

The western flycatcher is a sparse summer resident as indicated by the following records. An adult male was obtained on June 19, 1930, at 7600 feet in a cañon north of Kingston Creek. At 6700 feet in the main cañon another individual was observed on the same day (Miller). Another male was shot on June 5, 1932, on Wisconsin Creek at 7000 feet. This bird had been observed several times during the preceding 2 days, perched close to the ground in the thicket of birches bordering the stream. It was especially timid and disappeared, usually, at the slightest disturbance.

Myiochanes virens richardsonii (Swainson)

The wood pewee was common in the migration seasons in the Toyabe region, and a few doubtless remained to nest. Earliest dates of occurrence in spring were for birds seen in Smoky Valley, 5 mi. SE Millett, on May 15, 1930, May 20, 1932 and May 22, 1933. Records are numerous through the rest of May and early June at this locality and at the mouths of cañons along the eastern base of the mountains. The species was noted also about those ranches, out in the valley, where the houses were surrounded by trees.

In Smoky Valley, pewees were found in the thickets near pools and springs. At 8:30 a.m. on May 22, 1932, two were watched as they perched in willows and on dead sticks close to the margin, and as they flew over the water at a pond. One chased the other away from the shore. Fifteen minutes later both were fighting over a patch of cattails. Then, one was perched on, and feeding over, the cattails. Before I left, these 2 birds were seen fighting a third time.

On June 17, 1930, 3 pewees were chasing about over the tops of apple trees near the ranch house at 6000 feet on Kingston Creek. Later one was seen among rose thickets in the same vicinity. A male obtained on this date had testes 7 mm. long; it was obviously on its nesting ground (Miller). The same observer on June 20, 1930, detected this species in the cottonwood trees about the lower Smithline ranch.

In the fall wood pewees were collected on August 31, 1931, in willows on the Birch Creek meadow at 7000 feet and September 4, 1931, along Kingston Creek at 6000 feet.

Nuttallornis mesoleucus majorinus Bangs and Penard

On June 14, 1930, an olive-sided flycatcher was found on a dead spire of limber pine at about 9200 feet. The 2 or 3 acres of small scrubby pines stood on a steep northwest-facing slope south of Kingston Creek. The trees were interspersed with bushes and surrounded by sage. The bird proved to be a female with small ova. One was shot, June 2, 1933, from the top of a dead tree close to North Twin River, 6300 feet.

Otocoris alpestris leucolaema (Coues)

Horned larks usually inhabit the barest parts of a region, but this rule did not apply in the Toyabe area. The barest ground there was the alkali-covered flat in the center of Smoky Valley. Although horned larks occupied

ground at the margin of this flat, they did not go far out on it. Lack of an adequate food supply there appeared to be a possible limiting factor. Some physical conditions on this ground, however, may have been too severe for this bird.

We saw no horned larks in the mountains, though the species may occur sometimes at some spots there. All our observations on horned larks were made in Smoky Valley and in 2 belts in that valley. The upper one of these was the strip of scant vegetation at the upper rim of the valley and adjacent to the base of the mountains. Another center of lark abundance was the grassy strip bordering the alkali flat in the center of the valley. These 2 areas contrasted in type of soil, but they agreed in possessing a sparse cover of vegetation. In other ways, however, the vegetation differed in the 2 places.

During the last week of April, 1930, pairs of horned larks were spaced out over nearly all of the more scantily covered and drier part of the large pasture 5 mi. SE Millett. Singing birds perched on small mounds and, occasionally, on top of a bush as high as 3 feet. On the evening of April 22, after it had become too dark to shoot, several individuals were singing on the ground. A female collected on that date contained an egg nearly fully grown. The first young bird out of a nest that season was taken on May 18.

The pasture usually occupied by horned larks was flooded in the nesting season of 1932. Many pairs of horned larks were thus forced to hunt for new nesting sites. Apparently most of them moved only far enough to find the nearest dry ground and immediately started to nest again. The progressive spread of the water for several weeks tended to make continual change in the locations of certain pairs and to result in a crowded population in a belt around the margin of the flooded ground. Many hours were spent at this locality watching the birds to determine the nature of their responses to one another and to the type of ground.

On the morning of May 25, 1932, just outside the moist flooded ground a male horned lark was seen, and a test was made to see if it could be driven away. For 15 minutes it stayed within a definite territory approximately 75 yards across. When approached, it would fly and perch on a gopher mound or heap of manure. As the bird came near the boundary of its territory, it would permit closer approach and would make shorter flights. Finally it would circle and go back to about the center of the area. Three or 4 times, it went beyond the usual limits, and, immediately, another horned lark flew at it and drove it back to its own ground. At least 2 other lark territories bounded this one; one on the north and one on the south. When the foreign bird crossed the boundary of this one, the chase was reversed immediately. Twice this see-sawing continued 3 or 4 times and for several yards along the boundary before the birds separated and settled in their own grounds. Finally, this bird rose, took a course over the flooded ground to the southeast, and flew swiftly for at least 200 yards before settling.

When I turned back, I saw a female on the original territory, walking and picking at food objects. After 15 minutes, I could see the bird no longer and thought it had gone on a nest, but I was unable to find one. Later this

or another female was watched here, but it too rose and flew off to the south.

Around 7 o'clock the next morning observations were made on this same territory. For a quarter of an hour the male fed over the ground, sometimes running, usually walking, and going onto every gopher mound or other raised place and singing. Once it rose in spiral flight, sang 3 times on set wings, then dived to the ground and flew at another horned lark that was in this territory. The latter paid no attention to this, but it soon flew off voluntarily toward the north.

Several pairs were watched on May 28, as they foraged over the nesting ground. One female on a territory that had been watched before seemed especially excited. As it moved near the edge of the territory, its mate kept between it and a male from an adjoining area. The first male finally drove the latter away.

On the morning of May 31, several pairs were watched as they fed over this ground. Usually the birds would fly off after feeding for several minutes. Two individuals were seen on small mounds, drying their feathers and preening; it had rained earlier in the morning. Near the fence at the base of a corner post I found the shell of a horned lark egg that had been dropped there after hatching.

In the 1933 season the part of the pasture that had been flooded had so heavy a cover of vegetation that no horned larks were seen there. Thus for 2 separate reasons in 2 successive years they did not nest on ground which is usually suitable for them.

In 1933, 3 nests were found in the barest part of a pasture 5 mi. SE Millett. One was discovered at noon on May 21 when a strong wind was blowing from the south. The brooding bird flushed when the observer was 10 feet away. The nest was facing the north, and it contained 3 eggs. An approach to it had been built of small blocks of mud. On May 23 when this nest was examined at 6:45 a.m. and again in the evening, no bird was on it. Two days later there was no bird on the nest at 6:30 a.m., but the female was flushed from there at 12:30 p.m. When approached within 6 feet, the bird left and flew about 20 feet where it settled on a small pile of earth and watched the intruder. At 5:50 a.m. on May 29, this nest contained only 2 eggs, and no bird was brooding. Apparently it had been deserted.

Another nest found on May 21, contained a single small young horned lark. At 6:30 a.m. an adult flew to this nest after gathering food near 2 other horned larks 150 yards away. Later the parent bird perched on a piece of cow dung 15 feet from the nest and preened for 10 minutes and then walked to the nest. In the evening of May 23 the brooding parent flushed from this nest when approached within 40 feet. By May 28 the young lark nearly filled its nest; by noon it was gone.

The third nest was found on May 23, and it contained 3 eggs. Like the others this one opened to the north with a slight cover of rooted sedge stems shading it from the south. Both the male and female fed in the surrounding area without actually going to the nest for more than half an hour, and then they flew off toward the east. This nest held 2 small young birds when

examined in the afternoon of June 1. A parent stayed on the nest until I stepped within 2 feet of it. The nestlings were covered on top with dense, yellowish tan down. Possibly the third egg had been removed by the parents. Both young birds were gone from this nest on the evening of June 2. The nest was undisturbed except for a small hole, about the diameter of a horned lark egg, directly in the bottom of it.

On May 27, 1932, about 10 horned larks were watched in bare parts of an alfalfa field close to South Twin River, 6000 feet. At 3:30 p.m. a horned lark uttered single whistles of alarm while perched on a fence post at the lower margin of the field. Half an hour later 2 adults were perched on posts near there, one of them with its bill full of insects. This one flew west across the bare area. When it had gone 15 yards, it dropped to the ground and rose again, apparently with more material in its bill. It flew on for another 15 yards and then lit and started running. I lost sight of it after it had gone 10 more yards. Upon going to that spot I found a single young bird just out of the nest, squatted on the ground. For the next 15 minutes a male in the near vicinity sang almost continuously from a perch a little over a foot above the ground in a dead sage bush.

At this locality numerous young horned larks were seen on June 9, 1933. One group of four probably consisted of both old and young birds. Several individuals were foraging in the sage brush around the alfalfa field. One was walking on the ground among the bushes and occasionally picking off objects from the stems and foliage. Another individual was seen perched nearly 10 feet up on a wild-peach bush. Two larks, noted here a few days later, when disturbed, flew to the tops of sage bushes 2 feet high. One was seen perched on rabbit brush 3 feet above the ground.

Tachycineta thalassina lepida Mearns

The violet-green swallow occurred in considerable numbers in the Toyabe region both as a transient and as a summer resident. Transients were seen mostly in the lower valleys where the fields, marshy areas, and pools doubtless provided the best places for feeding as the birds moved to the north or to the south. Small groups of individuals often interrupted their foraging or their migration flight to rest on the tops of posts, especially where these were near pools. Once, on May 15, 1932, a western kingbird was seen to chase a swallow from such a perch. Sometimes these swallows fed over the desert. The earliest migration date is April 23, 1930, when four were seen and one shot in Smoky Valley, SE Millett. The latest fall record is for one seen on September 10, 1931, in the same vicinity.

All nesting colonies of this bird seemed to be in the mountains, usually on some rock outcrop at the top of a ridge or on a cliff near a meadow or stream. Adjacent open ground for foraging added to the desirability of the sites, but the birds appeared to go long distances—several miles—to feed. They were seen regularly in Smoky Valley through the summer even though no possible nesting site was known to be within 5 or 6 miles. They tended to appear over the low ground when storms covered the mountains. These individuals usually appeared late in the morning, as if they waited to be

forced by hunger to travel so far to feed. It seems unlikely that a bird which depends so completely on the capture of insects on the wing would be able to survive a whole season if it had to stay in the mountains close to its nesting site. The warmer, low valleys here seem to be a necessary part of the habitat, even if they are removed by several miles from the nests.

On May 28, 1932, a small group of violet-green swallows was feeding near a pond in Smoky Valley. There were 3 birds at 9:40 a.m. They kept to the north side of the pond, possibly because insects were carried to them from the vicinity of the water by the strong south wind. As soon as they reached the pond, they turned back and approached it again, and this was repeated often for at least 10 minutes. When flying with the wind, the birds were at least 100 feet above the ground, but when flying into the wind, they kept much lower, usually within 20 feet of the tops of the bushes. The birds did not fly in a straight line, but they swung from side to side with the result that each could examine a wide strip. During an exceedingly strong gust of wind, the swallows merely drifted backward, instead of turning and heading away from it. The 3 or 4 individuals always advanced together but never directly following one another or even close together. However, they spaced themselves out horizontally or vertically (Orr). Once, when 1 bird came to a position 10 feet behind another, a note from the front one sent the follower to one side. These observations serve to illustrate a plan of foraging behavior that conceivably could increase the efficiency of a small group in hunting for food. At least it was of evident advantage in this instance.

Some degree of jealousy over the feeding ground was noticed on June 7, 1932, when violet-green swallows and Pacific nighthawks were feeding over the same meadow. Whenever a nighthawk came near the swallows, one or two of the latter would dart at it and utter a twittering series of notes (Orr).

Swallows were watched about a cliff in Mahogany Cañon on June 11, 1930. Four pairs were counted, but most of them appeared not to have definite nest locations. They would fly to various places on the rocks and perch and twitter but would not enter crevices or crannies. One pair, however, appeared to have a nest in a small 6-inch pot hole on the face of the cliff about 6 feet from the top. One bird could be seen in this cavity, and every few minutes a second one would come and light on the rocks beneath it; both made twittering sounds. Occasionally both birds would leave the nest cavity together. Rarely would they return together; they seemed to have difficulty in making a landing. Although both approached simultaneously, one would have to leave and wait until the other had gained a foothold and had become settled (Miller).

At Birch Creek many violet-green swallows fed over the meadow at 7000 feet, and some pairs nested at the big outcrop of rock near by. One was seen on June 22, 1930, to enter a nearly vertical crevice halfway to the top of the cliff.

Riparia riparia riparia (Linnaeus)

Four bank swallows identified among migrating swallows 5 mi. SE Millett

were the only ones noted in the region. Dates of occurrence were May 14 and 17, 1930, and May 24 and 27, 1933. All 4 individuals were seen at close range as they flew toward the north. All were noted in the morning.

Stelgidopteryx ruficollis serripennis (Audubon)

Four spring dates, April 27 and May 15, 1930, May 16, 1932, and May 18, 1933, represent the only occurrences of the rough-winged swallow in the Toyabe area. All the birds were alone or in small groups feeding over marshy areas or ponds 5 mi. SE Millett in Smoky Valley. They were seen in mornings. One individual was in a mixed flock of cliff and violet-green swallows. A specimen was obtained on April 27, 1930.

Hirundo erythrogaster Boddaert

Barn swallows migrated across the Toyabe area in considerable numbers, and they nested about buildings at almost every ranch. April 24, 1930, was the earliest date for the species and September 9, 1931, the latest, but these possibly are not true extremes. Migrating birds were seen alone or with swallows of other kinds usually foraging as they moved to the north over wet ground or pools of water.

On May 29, 1932, at 10:30 a.m. a barn swallow joined violet-green swallows and fed with them over a pond for several minutes. Compared with that species in flight, this individual seemed to take a straighter course, that is, when it started across the pond, it was more likely to go entirely across without abrupt turns. However, it demonstrated its ability, when necessary to make short, swift turns.

The only individuals of this bird not recorded in the lower valley were two seen by Miller, June 21, 1930, in flight over the meadow on Birch Creek, 7000 feet.

Beginning of possible nesting activity was noted, June 1, 1930, 5 mi. SE Millett, when 2 individuals were flying about, and in, a vacant cabin there. One of them, a male, that was shot had gonads 5 mm. in longest diameter. A nest on the side of a beam at Millett, was completed, or nearly so, on June 3, 1930. Feathers of the lining were projecting over the edge. Swallows were in flight about the buildings. On June 5, 1933, at the same place a pair was making a second attempt to build where a first nest had been torn down.

On June 9, 1932, a nesting colony of about 5 pairs was examined at the Lincoln Highway bridge across Reese River. I counted 10 birds, in the air at one time, flying under the bridge and over adjacent ground and calling as if in protest at our presence. Orr saw 3 nests, one with 4 eggs, one complete and empty, and one he could not reach because it was over water. The floor of the bridge was only 3 feet above the ground and water. Two nests, examined at this bridge on June 22, 1933, contained 4 and 2 young.

Petrochelidon albifrons albifrons (Rafinesque)

Cliff swallows migrated across the Toyabe area with other kinds of swal-

lows, and they remained to nest wherever they found suitable conditions in the mountains or the valleys. Spring migration was noted each year all through May in Smoky Valley. The earliest record was for April 24, 1930, when one was seen 5 mi. SE Millett.

On June 1, 1930, at Millett, several cliff swallows were starting nests over the front door of the storebuilding. The birds had not been noticed earlier that season by persons living there. In previous years the birds had tried to nest there, but always their nests had been torn down by human occupants of the building.

At Birch Creek, 7000 feet, on June 22, 1930, 2 nests complete and 1 partly built were found on the large rock outcrop above the meadow. They were attached to the lower sides of projections halfway to the top of the rock. Swallows entered each of the completed nests. A bird entered one and shortly afterward was seen at the entrance. It then withdrew into the nest, and when it next appeared, it had in its bill some large object which it dropped outside. It withdrew again and did the same thing. Next, another adult arrived and entered the nest, and the first one left. Birds which entered the other nest did not stay for long. Watching these birds 2 days later resulted in the conclusion that they were feeding young.

On the same date of 1933, we saw a flock of about 50 cliff swallows at the Lincoln Highway bridge over Reese River. They appeared to be just beginning to nest. We could find only bases of 2 nests and one recently completed one which was not examined. All the birds seemed much concerned at our presence, and they flew close by with loud chattering. The cement stringers were about 4 feet above a pool of water, and all nests were over water although otherwise the beams were alike whether over mud or water.

Aphelocoma californica woodhouseii (Baird)

The resident Woodhouse jay was found regularly in small numbers about every locality worked, from a little over 6000 feet, near the base of the mountains, up to about 9000 feet on the ridges. Individuals or family groups were found in the thickets of willow and birch along the streams and in the piñons and mountain mahoganies on the adjacent slopes and ridges. Close adherence of this bird to the mountains was emphasized by the complete absence of any records of the species in our notes for any locality out in Smoky Valley.

Typical behavior of one when disturbed was illustrated by a jay seen on June 2, 1932, near Wisconsin Creek. When first noticed, it was in the top of a piñon 50 feet from me. The bird uttered alarm notes, bobbed, and when leaving its perch, dived abruptly downward toward the base of the next tree. Another individual was watched on June 16, 1930, in Kingston Cañon (Miller). This one was moving through the sage and piñons, keeping clear of the birches in the cañon bottom. It would stop for about a minute and then move on in bounding flight, going about 75 yards at a time. The notes of this bird were thought to be weaker and less raucous than those of the races in western California.

A female shot on April 29, 1930, contained ova not yet enlarged. A young jay which had recently left its nest was shot, May 30, 1930, on Wisconsin Creek.

An occupied nest of this bird was found on June 4, 1932, on the top of a ridge, at 9000 feet, near Wisconsin Creek (Orr). A jay was seen to slip away through mountain mahoganies and piñons. About 100 feet from there and 30 feet down a south-facing slope a nest was found in a piñon. It was 7 feet above the ground, resting on the outer part of a limb and supported by small twigs. The outer part of the nest which was 10 inches in diameter was composed of small and medium-sized twigs of sage brush. The inner part was 5 inches in diameter and $2\frac{1}{2}$ inches deep. It was composed of fine grass stems and lined with porcupine hair. The nest held 2 young that were nearly completely feathered, with primaries and rectrices just growing out. There was also an unhatched egg in the nest. When disturbed, the young birds opened their mouths but made no noise. The single parent, the only adult seen, remained near by, slinking about in the trees and making no noise until the intruder moved 75 feet away and remained quiet. It uttered a single *chuck* twice in 2 minutes and then flew from tree to tree approaching the nest.

At mid-day on June 3, 1932, a group of young just out of the nest was found on a ridge near Wisconsin Creek (Orr). First an adult flew up. About 100 feet farther, in a small juniper, a young one was found. It was barely able to fly from branch to branch. When first discovered, it was near the ground, but it managed to hop from the juniper to a mountain mahogany where it remained. The vacated nest was found near by, in a mountain mahogany, 5 feet above the ground, on the east side of the tree and on a southeast-facing slope. The nest was about 9 inches in diameter and was composed of small twigs. The cup was 5 inches in diameter and an inch deep. It was made of small grass stems and horsehair.

The next morning, at the same location, 4 young birds were found. Both parents were present, and they were feeding the young ones. During this process the adult made no sound, but feeding calls were uttered by the young. Once when a young one was preparing to fly to one of its parents following the other, a slight movement by the observer resulted in a sharp call from a parent jay. Following this the young bird remained perfectly quiet for about a minute. It then began to move about, but another warning call caused it again to become silent.

Near Ophir Creek, on June 4, 1932, an adult came, with anxious notes of alarm, to a thickly growing clump of piñons and mountain mahoganies and perched. At least 2 other jays, young ones recently out of the nest, were present in the clump. Their notes were different from those of the parent. In response to squeaks made by me the adult appeared to become frantic. It came to within 10 feet of me and uttered calls more loudly and more often than at first. The young birds stayed, but they became quiet. After 10 minutes the adult jay became quiet.

On June 19, 1930, near Kingston Creek, I saw 2 adult jays at 7200 feet

in tall shrubs, mountain mahogany, and aspens. They were quiet after the first outbreak of calls, but they kept close to me. One was carrying insects in its bill, and the whole behavior of the birds indicated that a brood of young was near by.

Pica pica hudsonia (Sabine)

The black-billed magpie was one of the characteristic birds of the Toyabe area, and a special study was made of it there, but the results of it are not included here because they have been used in another publication (see Pac. Coast Avif. No. 25, 1937).

Corvus corax sinuatus Wagler

Ravens were present, probably throughout the year but not in large numbers on the area studied. The few occasions when this species was noticed are as follows: At Birch Creek, 7000 feet, on August 31, 3 ravens were flying high over the mountains toward the southeast; each alternately flapped and sailed. At the same place calls of this bird were heard several times on September 2. In Smoky Valley, 5 mi. SE Millett, ravens were noted singly or in two's on May 19, 20 and 31, and June 7, 1932, and May 20 and 25, 1933. On the last date two were seen with crows.

Corvus brachyrhynchos hesperis Ridgway

Crows were found regularly each summer in a small area about 6 mi. SE Millett, in Smoky Valley. Here the buffalo berry and willow thickets seemed to be high enough for perching and nesting sites and the expansive open pastureland provided productive forage areas. Thus accommodations were available for a small colony. None was found elsewhere in the region. Even when crows were nesting, we saw them most often in flocks. These numbered usually about 12 individuals. The largest flock seen was perched in a willow thicket close to Rogers ranch in the afternoon of May 31, 1933; 14 crows were counted in it.

On several occasions crows were seen mobbing great horned owls. Once a small bird of undetermined species, was seen pursuing a crow.

Two nests were found in this vicinity in 1933 by Compton. One on May 22 was 12 feet up in a buffalo-berry bush in a dense thicket of those bushes. It was made of twigs of buffalo berry and lined with shreds of willow bark. The brooding adult flew off when a stick was thrown into an adjoining bush, but it flew back and forth overhead while the intruder was near. Five eggs made up the set. These were evidently on the point of hatching, for on May 25 there were 5 young which appeared to be 2 days old. This time the brooding bird flew off when the observer was yet 10 feet away. Both parent birds flew overhead, protesting at the intrusion.

On June 11, a second nest was found, containing 4 young, fully feathered and nearly ready to fly. This nest was 10 feet up in a partly dead buffalo-berry bush. At first the 2 adults circled but came no nearer than 100 feet. When a young one from the nest began making sounds, they came nearer and became more excited. Soon there were 6 adult crows circling and cawing

above the nest. Even a magpie came in response to the disturbance, but it was driven away by one of the crows. The magpie took refuge in the center of a buffalo-berry bush.

Cyanocephalus cyanocephalus (Wied)

In the Toyabe region piñon jays were most often seen close to the base of the mountains. Scarcely ever was one seen above 8000 feet. Downward, however, the flocks sometimes ranged out to the center of Smoky Valley. Beyond a rather obvious choice for trees and particularly for piñons and junipers, not much was learned of the nature of the habitat restrictions of this bird. The rather casual attachment for any locality exhibited by this species is illustrated by the records which show that nowhere, with 1 exception, was it seen twice in the same locality. This may be accounted for in part by the comparatively small number of individuals present in the whole area.

Places where piñon jays were observed were as follows: Ophir Creek, 6500 feet, May 17, 1930; Kingston Creek, 7200 feet, June 17, 1930, 6000 feet, September 7, 1931; Austin, June 16, 1931; Mohawk R. S., June 18, 1931; Last Chance Creek, 6000 feet, May 23, 1932; South Twin River, 6500 feet, May 27, 1932; 1 mi. S Millett, June 10 and 14, 1933; Wisconsin Creek, 6000 feet, June 6, 1932; Summit Creek, 6300 feet, May 26, 1933. On many of the occasions listed above the birds were in flight. However, they were noted a few times in piñons, sage brush, willows, cottonwoods, and buffalo berry.

No nests were seen, but on 2 occasions flocks were watched which included young birds barely able to fly. Once, on June 18, 1931, more than 10 adults and young were seen in large piñons on the north side of a ridge close to Mohawk R. S. Evidently more than 1 family had banded together, but in a scattered company, so that usually not more than 2 or 3 birds were present in 1 tree. Old ones appeared to be no more wild than young ones. One of the adults had several small weevils in its mouth and gullet. Apparently the group was feeding upon insects.

On May 27, 1932, about 8 a.m. a flock of about 100 piñon jays was watched in the area between the cañon mouths of North and South Twin rivers. The flock, composed of old and young birds, was foraging among sage bushes close to the base of the mountains. Some birds were perched in trees along the creek but, mainly, they were scattered on the ground. All adults were busily walking between the bushes looking for food (insects?). Occasionally one would perch, but for a short time only, on top of a bush 1 to 2 feet high. Calls were uttered infrequently. Each adult had at least 1 young bird following it and begging for food, and some had 2. When the adult flew, the young followed directly behind and as closely as possible. When the old bird went to the ground to search for food, the young one perched in the top of a bush close by and gave begging calls supplemented by quivering, spread wings and open mouth whenever the old bird came near. At least once an old one was seen to fly to, and feed, a young one thus perched. The young appeared not to attempt to forage. There seemed to be at least $\frac{3}{4}$ as many adults as young in the group.

One mi. S Millett, in Smoky Valley, June 10, 1933, a flock of 54 piñon jays flew from the tops of a clump of buffalo-berry bushes at the roadside when we rode past.

Nucifraga columbiana (Wilson)

Clark nutcrackers were among the most conspicuous birds in the Toyabe Mountains. Their characteristically loud calls and their habit of perching in exposed places and of flying high over the valleys and ridges insured that any individual would be surely detected by a bird watcher in its neighborhood. During most of the summer, when our observations were made, small family groups were the rule although single birds were often seen. On August 29, 1931, a flock numbering about 25, as well as several smaller groups, was seen near Birch Creek.

Nutcrackers were strictly mountain birds in the Toyabe region. They were seen most often in trees and in the higher parts of the mountains. At times they were found as low as the base of the mountains, but then they were probably on short foraging trips. These birds were noted in the following kinds of trees: piñon, juniper, mountain mahogany, cottonwood, birch, and limber pine. This list includes just about every tree in the range. Much time was spent by nutcrackers on the ground, especially at wet places near snow drifts and even on the drifts themselves.

A few examples of encounters with other kinds of birds were noted. On June 23, 1930, in early morning, a nutcracker that flew over a ridge near Birch Creek was actively pursued and driven away by Brewer blackbirds which nested there. In midafternoon of June 4, 1932, 4 nutcrackers were seen to attack a red-tailed hawk over a rocky ridge near Wisconsin Creek. When the hawk lit, the smaller birds perched near by, but they renewed the pursuit when the hawk flew up a moment later. None was seen to touch the hawk, but they made a great deal of noise.

On May 27, 1930, 3 nutcrackers were watched between 8 and 9 a.m. in a group of mountain mahogany trees near the top of a ridge, 9000 feet, close to Wisconsin Creek. One, thought to be an adult, flew into the air about 15 times and caught insects. After each trip, the bird returned to a perch in a dead mountain mahogany. There, a young nutcracker, well able to fly, would move over to it and utter begging calls. These were long, single syllables, hoarser than those of a magpie. A few times the wings were spread a little. Then the old bird would feed the insect, which it had caught in the air, to the young one. The trips into the air varied from 10 to 20 yards in length, and they were likely to be made in any direction. The insect was sighted from the perch, flight was made directly to it, and return to the tree was made immediately.

On May 28 an adult was seen feeding a young nutcracker perched on a bare limb. The young bird spread and quivered its wings and uttered loud, rapid notes. Always it was noticed that the young of this species were relatively tame, compared with the old ones, and they frequently came very near to a person. A young male obtained on May 23 had the clear, single walled

spaces in the top of its skull nearly closed. It is evident that this character would not be serviceable in distinguishing immature from adult birds, mainly because of early development of these bones.

A brood of young, just out of the nest, was seen on June 20, 1933, among limber pines, just below the upper limit of trees. The nearly grown young birds were scattered, and their parents were near them. Attention was attracted to them by their peculiar cries which were loud, harsh squawks, kept up for as long as I was near by. They were first heard from a dead, fallen tree and then from perches close to the ground.

Penthestes gambeli inyoensis Grinnell

Mountain chickadees inhabited all parts of the Toyabe mountains, where there were trees. Apparently the kind of tree made little difference to the birds. Observations on chickadees involved the kinds of trees in the following list and between the altitudes indicated: cottonwood, 6500-7000 feet; juniper, 7000 feet; willow, 7000-8000 feet; aspen, 7000-8500 feet; piñon, 7000-8000 feet; birch, 7000-8500 feet; mountain mahogany, 7500-9000 feet; limber pine, 9000-10,000 feet.

Aside from the need for cavities in trees for nesting sites, nearly all the requirements for the daily life of a chickadee were fulfilled in these trees. No particular evidence was obtained that indicated a choice between conifers and deciduous trees. The birds were seen as often on the dry ridges as in the cañons and near streams. However, during the summer season, when our work was done, none was found out in the valley, away from the mountains, even where there were trees. Possibly this bird moved out to these places in winter.

Near Wisconsin Creek, 7000 feet, on the morning of June 5, 1932, observations were made upon a single chickadee. At 9:30 a.m. when there was a strong, cold wind from the west, this chickadee was perched on the east side of a willow clump on the lower part of a rock slide. The bird was on a dead branch 6 feet above the ground and halfway to the top of the clump. For about 5 minutes it preened, picked at the breast feathers with its bill, and, several times, scratched the sides of the head alternately with the claws. Then the bird flew to a cottonwood by the creek where it foraged for another 5 minutes mostly over small twigs near the center of the crown. It called occasionally although no sounds were heard during the preening.

On June 11, 1930, in Mahogany Cañon 2 chickadees were obtained in limber pines at 9700 feet. The birds were traveling, though staying within about 20 feet of each other. Examination of the two indicated that they were a pair. When one was shot, the other refused to leave the vicinity. One was heard in this neighborhood the next day. The song differed from that of the Sierra Nevada birds in having 3 or 4 notes before the drop in pitch. The drop in pitch also was greater, being in this instance a perfect minor third, that is, a tone and a half (Miller).

Several chickadees were watched on June 4, 1932, near Ophir Creek. They were foraging among piñons and sage brush. Of 2 adults that were together,

one fed the other twice in rapid succession. Both then continued foraging, mainly on the terminal twigs of piñon, or the new growth on those trees. They moved rapidly from 1 twig to another and inspected about 100 of them in a 5-minute period. Both birds uttered a variety of soft, low notes such as I had not often heard. Apparently these were given in answer to each other. One bird held an object down on a twig $\frac{1}{4}$ inch in diameter and pounded it with the bill for about a minute. The sound thus made could be heard at least 25 feet away.

Two chickadees were seen nest-building on May 23, 1932, near Last Chance Creek. They were in a dead cottonwood and from there flew off to piñons. The nesting material was brought to a hole in the main trunk of the tree which stood next to the water. The hole was 20 feet above the ground. One bird only of the pair was carrying material; the other followed.

An egg was taken from a nest found by Lamb on June 4, 1930, near Kingston Creek. The entrance to the cavity was only 8 inches above the ground in the trunk of a mountain mahogany. The brooding bird flew from the nest when approached.

Psaltiriparus minimus plumbeus (Baird)

During the first 2 summers spent in the Toyabe region the bush-tit was a common bird of the lower part of the mountains, between 6000 and 8000 feet; noted once as high as 8700 feet. Although much less time was spent in the mountains in 1932 and 1933, no bush-tits were recorded. This indicates a marked reduction in numbers of this species, but there is a possibility that the records merely reflect a diversion of our attention to other species.

Prominent among the kinds of plants frequented by bush-tits were the following: tall sage brush, piñon, mountain mahogany, birch, willow, dogwood, limber pine, and aspen. The species occurred over the ridges and along the streams; the greatest numbers being found on the floor of cañons near their mouths at the base of the mountains. Aside from the habitat preference reflected in the type of vegetation indicated above, our field observations showed no effective kind of environmental restriction. Characteristics of the plants, probably important, were their medium height and scattered arrangement. There was an apparent limit to the desirability of scatter; members of a flock hesitated to cross openings wider than a few yards.

Further features of bush-tit habitats were indicated by the surroundings of nest locations. Two nests were found on May 22, 1930. One was 25 feet above the ground and 2 feet below the top of a birch at the side of Wisconsin Creek, 7800 feet. Two near-by adults kept chattering for several minutes. It was supposed that they were incubating eggs or brooding young. The nest was much grayer than the brown limbs of the tree which was hanging full of flowers, and whose leaves were just coming out. Another nest near the same stream was 6 feet above the ground and in the periphery of a piñon half way to the top. The empty nest was completed or nearly so. Two adults were calling anxiously near by.

At 8 a.m. the following morning a pair in this vicinity was watched gathering nesting material from piñons and mountain mahoganies on a steep

north-facing slope. Their nest was 15 feet up and close to the bole of a spindling piñon 20 feet high which grew in a stand of piñons and mountain mahoganies close enough together to shade more than half the ground. The few scattered small sage bushes were mostly dead ones. The nest, which had its final shape, was hidden from my view on every side except upslope. The female, when examined, was found to contain large ova and to have a well-developed brood patch although the nest was not yet finished.

A nest which appeared to be a new one, although no bird was near, was seen on May 30, 1930, at 8000 feet on Ophir Creek. This one was nearly 20 feet above the ground in a birch at the stream side.

On May 31, 1930, another nest was found at the base of a slope on Wisconsin Creek at 7800 feet. The site was 12 feet up in the center of a mountain mahogany 15 feet high. During several days that these birds were watched, they together made trips to the nest with material and worked back and forth across the valley, along the creek and a little way up the slopes.

The earliest family group out of the nest was recorded on June 5, 1930, at 7500 feet on Kingston Creek. The birds were foraging at 6 a.m. among mountain mahoganies which were then in bloom, and one was being fed by a parent. On June 12, an adult was followed to its nest suspended from a limb $\frac{1}{4}$ inch in diameter near the top of the crown of a mountain mahogany (Miller). The nest was heavily lined, thick-walled, and the entrance was built out so as to make a covered passageway. The bird left after being in the nest for 30 seconds. The nest contained nearly grown young, as yet poorly feathered. The skin was black but the complete outline of the mouth showed bright yellow. The eyes were open.

In the morning of June 18, 1930, 2 bush-tits showed concern at my presence in thickets near Kingston Creek at 6600 feet. They were carrying food which they picked off small twigs and leaves mostly in the tops of birches; evidently a nest of young was near. One of the birds moved down into tops of dogwood bushes, but a Tolmie warbler came up from near the ground and drove it away.

The next day a pair showed concern about a mountain mahogany on the floor of a side cañon of the same creek. A nest was found 12 feet up, fastened close to the top of a central branch of the tree. It contained 6 young nearly feathered. Four of these were taken out, and the other 2 jumped out of the opening at the side of the nest and fluttered to the ground. Then the adults became more excited than any I had seen in the region. They flew about the tree and rapidly uttered loud notes. Within a few minutes, however, 1 parent was pecking at some object on an upper twig of a piñon. The feather-lined nest was composed almost entirely of the dead (curley, feathery) flower parts of mountain mahogany. The tree was 75 feet from birches lining the streams and was surrounded by sage brush, a few piñons, and mountain mahoganies.

On Birch Creek, a nest was found, June 25, 1930, 20 feet up, near the top of a vertical trunk of a slender birch. The nest was only partly shaded. It was visited by both parents and was thought to contain young. The next

day, on the same stream, a bush-tit was seen which appeared to be carrying nesting material.

Two observers in the Toyabe region noticed that the notes of bush-tits there differed from those of the California race. The notes of the Nevada birds were noticeably heavier, clearer, and louder, the 2 parts more distinct.

Sitta carolinensis tenuissima Grinnell

The white-breasted nuthatch was resident high in the mountains. The small forest of limber pines on the upper western slopes of Bunker Hill, 9000 to 10,000 feet, supported the largest population found in the mountain range. The species was noted there on June 11, 1930, June 29 and September 2, 1931, and August 17, 1932. Usually only 1 or 2 pairs were seen. A female shot on June 11 was in the midst of egg-laying.

On May 26 and June 13, 1933, white-breasted nuthatches were found among piñon pines on slopes adjacent to Summit Cañon. On June 20, 1933, 2 individuals were seen among limber pines above 10,000 feet on Arc Dome. Both foraged over dead trunks of trees. One showed much concern at the presence of a mountain bluebird.

Sitta canadensis Linnaeus

On August 29, 1931, a red-breasted nuthatch was shot as it moved over the trunk of an aspen close to Birch Creek above the meadow at 7000 feet. Attention was directed to the bird by its single note. On the morning of August 31, one was seen among birches and aspens in a side cañon south of the same creek, and in the afternoon another one was shot a short distance farther up the cañon. Both these birds were immature males.

Cinclus mexicanus unicolor Bonaparte

Dippers were noted along Birch Creek, Kingston Creek, and North Twin River. One specimen was obtained on Kingston Creek, 7000 feet, June 16, 1930 (Lamb). The testes were black and measured about 6 mm. long.

A dipper watched on this date was moving along the margin of Kingston Creek picking insects from beneath the water. Part of the time the bird walked in the water and part of the time on the bank. Once it was out on the bank as far as 3 feet. When its bill was filled with insects, it flew upstream. At the place where the bird went, the bank was undercut, and a shrill, screeching call was heard. Evidently, young were being fed in a nest beneath the bank there. Next the dipper floated downstream for about 8 yards and took flight from the water. Within a few minutes one carried insects on several trips to the site of the supposed nest. Twice another bird was seen. In foraging, the bird sometimes inspected, and picked insects from, the sides of sticks that were partly under water.

On June 25, 1930, a dipper was seen on Birch Creek just below the meadow. It perched, with bill full of insects, for about 2 minutes on a stick just over the water. The bird bobbed, sometimes just the head and sometimes the whole body. Later one stood, 15 feet from me in midstream, on a stone

over which water was running, and gave alarm notes, meanwhile bobbing forcefully.

A nest found, June 8, 1933, on South Twin River at 6800 feet was on the west bank of the stream on an almost vertical face of rock, about 3 feet from the water and at the base of a small patch of green plants. The stream below was about 6 feet wide, and the water was rapid and churning. A rock on the bank opposite the nest was covered with many droppings. On the morning of June 17, a parent was seen feeding young birds at this nest. It did not enter the nest but hovered at the entrance and delivered the food with much metallic twittering. When the nest was touched, 2 of the 3 young ones jumped out into the water and floated out of sight. Later the third one jumped out. It dived and swam under water at first and then came up and floated downstream out of sight.

A second nest was found, June 17, 1933, at 7100 feet along the same stream. It was 6 feet from the surface of the water, supported by a small rock ledge, and there was a wide overhang of rock. The nest was made of moss with an entrance $2\frac{1}{2}$ inches high and $3\frac{1}{2}$ inches wide. It felt distinctly damp inside; a seepage of water kept most of it damp. Most of the moss was dry and dead, but some in the lower part of the nest was alive. On the bank opposite this cliff there were no trees, but there were 2 or 3 small, dead birches. In the nest were 3 young about $\frac{3}{4}$ grown. A few tufts of down remained on their heads and necks.

On June 19, 1933, in a small gorge at 7000 feet on North Twin River, adult dippers were watched as they carried food to young birds in a nest behind a 6-foot waterfall. Both parents carried food to the nest. Two old nests of previous seasons were found about 35 feet downstream.

Troglodytes aëdon parkmanii Audubon

In the mountains house wrens lived in many situations, but they were found usually among trees especially where there were brush clumps or other thickets close to the ground where forage places and screen were provided. Such situations occurred mostly along the streams and in the aspen groves. Dead trees or groups of them were more likely to supply the required surroundings than living ones. Sometimes wood piles or rocks, piled as in fences, provided the features necessary to attract house wrens.

Dates of observation of this bird in the mountains were between April 30 (1930, at South Twin River, 6500 feet) and September 7 (1931, Kingston Creek). The only one seen in Smoky Valley, 5 mi. SE Millett, probably a transient, was noted on May 18, 1933.

For 15 minutes on May 24, 1930, 2 wrens were watched about a group of aspens at the side of Wisconsin Creek, 8300 feet. Both seemed to be particularly nervous. One moved over leafless branches near the ground and sang almost continuously. The other one uttered coarse call notes in rapid succession and kept near the main trunks of the trees. It entered holes and cavities about 6 times, but each time it came out again immediately. Three or 4 times when the birds came near each other, they opened their bills, flew

together, and fluttered to the ground. Finally, they moved off up the creek, but one returned in 10 minutes and made a note that sounded almost like a hiss. At the end of half an hour both birds were back and performing as they had at first but in another part of the tree group. In this grove the leaves were just beginning to come out.

Songs of the house wren were heard at this location in the evening of May 24 and in early morning of several succeeding days. A female was caught there on May 27, in a mouse trap set beneath a sage bush. Its largest ova were the size of dust shot (Lamb). This was thought to be the same bird I had seen, on the 24th, prospecting for a nest site. The 2 birds were considered to be a mated pair.

Nesting places of house wrens in the Toyabe Mountains were most often the deserted holes made by woodpeckers. A majority of the ones found were in the trunks of aspens. Some were in artificial cavities in the trunks of trees, some were in crevices about buildings, and some were in cavities in rocks. Because of the nature of the nesting sites little effort was made to determine the contents of the nests.

Nests of the house wren found in the Toyabe Mountains:

Date	Location
June 22, 1930	Small pocket in top of cavern, 10 feet high, in rocky outcrop.
June 23, 1930	At 8000 feet, in cavity at knothole in main trunk of large aspen 20 inches in diameter. Hole 20 feet up from ground, on SE side of tree, shaded by other trees. One bird carrying grass stems here.
June 24, 1930	At 7500 feet, in cavity in aspen 5 feet above ground; adult brooding at least 4 eggs.
June 20, 1931	Nest 6 feet up in woodpecker hole in aspen.
June 20, 1931	Nest 4 feet up in hole in aspen, 100 yards from last.
June 3, 1932	At 8500 feet, in hole in aspen, 5 feet above the ground.
June 8, 1933	At 7000 feet, newly completed on sill over door in abandoned cabin, empty. Five eggs on June 17.

Telmatodytes palustris plesius (Oberholser)

On September 9 to 11, 1931, several marsh wrens were seen and 5 specimens obtained at 5 mi. SE Millett. The birds were seen in cattails in sloughs and in brush barriers around springs. On May 20, 1932, an old nest of this species built in some previous season was found in cattails in one of the ponds in the vicinity where the birds were collected in the previous fall. The nest was well preserved, with a small round opening near the top of one side. Although a careful search was made, no marsh wrens were found anywhere in the Toyabe region in the breeding season.

Catherpes mexicanus conspersus Ridgway

The cañon wren was resident; present in small numbers on the rocky cañon walls in the lower parts of the mountains. Specimens were obtained as follows. A male was shot, May 1, 1930, at 6800 feet on North Twin River, and a female, August 29, 1931, at 7000 feet on Birch Creek.

In the lower cañon of North Twin River, a cañon wren was watched, on April 29, 1930, in a deserted house. A nest, over a window, appeared to belong to this bird, but it was not examined closely. On July 6, 1931, a wren

was heard singing at the base of a cliff a little farther up this cañon. In Kingston Cañon this wren was found on June 16, 18, and 19, 1930, and July 3 and September 5, 1931, at altitudes from 6500 to 7500 feet. The only other record for the area is of the bird mentioned above from Birch Creek. Nearly every individual recorded was discovered first by hearing its distinctive notes. Most of the birds were near the bases of cliffs or large slides of rocks and close to the bottoms of the cañons. These parts of the cañons appeared to be more humid and, hence, to offer better forage situations for rock-haunting, insectivorous birds.

Salpinctes obsoletus obsoletus (Say)

Rock wrens had arrived and apparently were well established each season before our work in the region began. Except for 1 occasion, on May 17, 1930, when one was seen among sage bushes on the floor of Smoky Valley, 5 mi. SE Millett, every rock wren seen was on or close to rocks. In the mountains rocks were nearly everywhere, and the wrens were just as widely distributed. However, in spite of the rather universal spread of apparently suitable habitat, this bird was not especially numerous. Usually fewer than 6 would be seen in a single day, and on many days not one was seen. There is little to substantiate it, but the only plausible explanation I see for this sparse representation is that food suitable for rock wrens is not uniformly abundant and that the birds occupy the places where they find suitable forage. There is a distinct impression that the occupied areas would supply more food and are less barren than the unoccupied areas. However, some other factor may be equally, or more, effective in restricting the wren population here.

On June 19, 1933, a pair was seen above 9000 feet on the ridge which divides North and South Twin rivers. One of them held an insect which it carried to a rock and, judging from the sounds produced, fed to the other adult or to young ones. Later, when a bird, possibly a hawk, flew over high in the air, a wren gave alarm notes and the 2 adults flew to another rocky ridge. Since this species lives in exposed situations it must keep alert to avoid capture by predators.

Mimus polyglottos leucopterus (Vigors)

Mockingbirds were not found in the Toyabe region until 1933 when a nesting colony of several pairs was discovered in Smoky Valley 1 mi. E Rogers ranch. Probably the species had been present in earlier years when it might easily have been overlooked by us. However, just as in the black-throated sparrow, effort had been put forth to find this bird.

The area occupied by mockingbirds was one where buffalo berry constituted the chief vegetation, and where that bush along with rose, willow, and currant was scattered in small thickets with open ground between them. In other words the favored habitat of mockingbirds in this valley appeared to be a late stage in the development of the plant community of which buffalo berry was a conspicuous member.

These birds were first detected on May 29. A marked character of the group was their wariness. An individual invariably would disappear from sight

upon the least disturbance. Another impressive feature was the large size of the areas occupied. Each individual pair appeared to range over a territory $\frac{1}{4}$ to $\frac{1}{2}$ mile across. Intolerance for other birds was indicated a few times when mockingbirds flew after and drove Brewer blackbirds away from their singing perches. In 1 instance the same perch served, at different times, for a mockingbird and a wood pewee; each used it while the other was away, and no conflicts between the 2 were noted.

On June 15 a pair of mockingbirds in this colony was watched, beginning at 5:30 a.m. The birds appeared to use 1 bush as headquarters, but they spent at least half the time away from it. One individual (male?) always perched on top of this bush while the other (female?) was usually some place at the side. The nest was found by watching the latter fly down to a small bush about 30 feet away where it would remain for a moment and then fly back to the main thicket. While at the thicket the bird made this trip about once each 5 minutes. On no occasion did it enter the canopy of the thicket; it always perched in the periphery.

The nest which held 4 eggs was situated about 16 inches from the ground in a small clump composed of buffalo berry, rose and dead branches of buffalo berry. It was in the center of the clump and was composed of twigs of buffalo berry, rose, and another kind of thorny bush. That the nesting material had been brought in from the southwest was indicated by the many twigs that had caught on the branches of the bush.

On June 16 a nest containing 4 young was found in a small clump composed of rose, gooseberry and buffalo-berry bushes. The nest was supported by stalks of all three, and it was composed mainly of twigs from buffalo berry with a lining of fine grass, leaves, and wool. The site was about 14 inches above the ground and on the northeast side of the clump which was about halfway between 2 large thickets. The dead upper branches of buffalo berry in the northern one 30 feet away were used as a perching place by the birds.

A third nest found on this date was 18 inches above the ground on the northeast side of a rose bush 5 feet high. The nest was supported on a dead, horizontal branch of buffalo berry and it was shaded. It was loosely built of thorny twigs, lined with round grass stems, and contained wool in the rim. The site was surrounded by nearly bare alkali ground, on which there were willow clumps and a few dead clumps of buffalo berry. The 2 birds of the pair were seen perched 10 feet up in a bush 50 feet away. The nest contained 4 eggs. Another nest of mockingbirds was found only 100 yards away.

Oreoscoptes montanus (Townsend)

Sage thrashers in the Toyabe region were present in those stands of sage brush taller than the average and on fairly level, open ground. In the absence of sage brush, other kinds of bushes with a resemblance to that plant in growth form and arrangement were acceptable. Vegetation of this sort covered many patches in Smoky Valley, and also it occurred on the leveler tops of high ridges especially along the main divide in the mountains. This furnished an example of a species living in 2 habitats not far separated in miles

but characterized by dissimilar summer climates. The intervening, unoccupied gap altitudinally was nearly 4000 feet.

From 8:50 to 9:45 a.m. on May 24, 1932, a singing thrasher was watched on a *Tetradymia* bush on the sand dunes near the alkali flat in Smoky Valley. The bird perched on top of the bush and faced the hot sun as it sang. The length of the song varied usually from 10 to 15 seconds, but once the bird sang for as long as 2 minutes and 45 seconds without stopping. The intervals between songs were around 8 seconds long; 3 times in succession they were 30 seconds long (Orr).

A nest was found 300 yards from the singing bird. The brooding bird flew away when the observer was within 10 feet. The nest was in a *Tetradymia* bush on a little mound near the alkali flat. At this time the mound was surrounded by flood water. The nest was toward the north side of the bush, and its base was about a foot above the ground. In the nest there were 2 eggs and 2 small young that had just hatched, along with half an eggshell that had not been removed. Both young birds opened their mouths widely when the nest was touched. Both parents came near the nest, but they made no sound and kept at least 30 feet away.

On May 27, 1932, a nest was found near South Twin River, 6000 feet. Its rim was 10 inches above the ground in a sage bush 2 feet high in a strip 30 feet wide which projected below the lower margin of an alfalfa field. The nest was composed mainly of dead sage twigs and was lined with shreds of sage bark. Its base was 5 inches above the ground. No adult was seen on the nest, which contained 5 eggs, but one was seen perched on a fence in the near vicinity.

In the afternoon in this vicinity an adult thrasher was seen in a dead willow along a stream with bill full of insects. It flew down to a clump of sage, and a search revealed a young one 20 yards away. The young bird was perched 3 inches above the ground, where it was out of the wind, in a sage bush a foot high. Close by in a wild peach a nest was discovered 1 foot above the ground, its outer part of thorny twigs and the lining of shreds of bark.

A nest was found on May 20, 1933, in a *Sarcobatus* bush 7 feet in diameter and 5 feet high, among sand dunes 2 mi. SE Rogers. The nest was 2 feet above the ground on the northeast side of the bush, and it contained 4 eggs. The brooding bird when disturbed ran off for 30 feet. Materials in the nest were thorny twigs, and the lining was of fibers of bark.

On June 1 a nest was found 10 inches above the ground on the east side of a small sage bush just below the alfalfa field by South Twin River at 6000 feet. It was made of sage stems and lined with a few horsehairs and a mat of brown cow hairs mainly in the bottom of the cup. There were 5 eggs in the nest. The brooding adult flew off silently when I was 8 feet away, but it returned and moved in a circle on perches 8 to 30 feet from me. At first it made no sound, but later low chirps were heard. Low sage bushes 2 feet high surrounded the nest, but 20 feet away the area of low desert plants began.

Another nest found in this vicinity on June 2 contained 3 small young thrashers covered with tracts of blackish down and 1 egg. The nest was 8

inches from the ground in an isolated clump of rabbit brush. While a person was at the nest, both parent birds came within 6 feet of him. By June 9 the 4 young in this nest had lost their down. Contour feathers showed in all the tracts; primaries were about $\frac{1}{2}$ inch long.

Many old nests were found which because of their uniform structure and location were considered to belong to this species. Often several would be found in 1 group of bushes; once as many as 4 young of different ages were seen in a small area. These indicated a marked tendency of the birds to return for nesting to the same spot each season.

Turdus migratorius propinquus Ridgway

Robins were found in the mountains where there were groves of trees or clumps of tall bushes, and where there was open ground that was moist or wet and covered with grass. These situations occurred on meadows, close to the streams, and about seepy areas. Seasonally our records were all between April 30 (1930) and September 7 (1931), but the species probably was present in the region beyond those limits.

During the first ten days of May, 1930, when snow covered most of the Toyabe Mountains, robins were found frequently in groups in the piñons and junipers on the slopes and in the trees near streams close to the base of the mountains. On May 10, a group of about 8 was seen along North Twin River, 6500 feet, actively feeding in a thicket of rose which bore a heavy crop of ripened, red fruits. The air was warm at the time, and the birds were markedly active and noisy as contrasted with their behavior on some of the colder, cloudier days. These birds were later seen in trees along the creek and out in the sage.

At Kingston R. S. in early June (1930) robins produced the most notable of the bird songs early in the morning and late in the evening on the meadow. On June 6, the morning singing had stopped by 4 a.m. It was heard again in the evening, after sundown.

On September 5, 1931, a large group of robins was seen in early morning on an east-facing slope where sunshine hit early in the morning at 7500 feet near Kingston Creek. The birds were mainly in mountain mahoganies, but on the slope there were many chokecherry trees which may have accounted partly for their presence.

NESTS OF WESTERN ROBIN FOUND IN THE TOYABE AREA

Date	Contents	Situation	Altitude
May 30, 1930	4 eggs	9 feet up, in aspen near stream	8000 feet
June 6, 1930	4 eggs	6 feet up, in dead willow	7500 feet
June 12, 1930	empty	25 feet up, on horizontal limb of birch	8700 feet
June 18, 1930	empty	10 feet up, in birch at side of stream	6600 feet
June 21, 1930	4 eggs	5 feet up, in aspen	7000 feet
June 23, 1931	young	in chokecherry	7000 feet
June 23, 1931	3 eggs	6 feet up, in willow at edge of stream	6700 feet
July 1, 1931	3 eggs	5 feet up, in willow at edge of stream	8500 feet
June 8, 1933	3 eggs	6 feet up, in dead aspen	7700 feet

One nest apparently built by robins was found, June 22, 1930, on a small

ledge of rock in the top of a cavern in an outcrop near Birch Creek, 7000 feet. The nest was empty when found, but it seemed to be newly built.

Two adults with 2 young able to fly short distances were found on June 17, 1933, at 7100 feet in birch and willow trees along South Twin River.

Hylocichla guttata polionota Grinnell

The hermit thrush, one of the common birds in summer in the Toyabe Mountains, seemed to be most numerous at about 8000 feet, but nearly all the range where there were trees was occupied. The lines and groves of trees which grew close to streams were most certain to be occupied by hermit thrushes. Also they lived out over the ridges, on slopes covered with mountain mahogany, where the trees were close together, and where there was leaf litter on the ground. One factor of apparent importance in determining the presence of this thrush was the availability of shade. However, the shade was not dense in most of the territory occupied in this area.

Our records of hermit thrushes in the Toyabe Mountains range from May 1 (1930) to September 6 (1931). However, the birds doubtless were present beyond these dates.

Four nests were found on June 19, 1933, along North Twin River. One was near 8500 feet altitude, 6 feet above the ground in a dead aspen at the streamside and in a close-growing grove of aspens. This nest was built directly on top of an old one of a previous season. The total outside depth was 18 cm., of the new part 10 cm. The rim inside measured 60 mm.; outside, 140 mm. The 4 eggs were not being incubated when first seen, but an adult thrush was seen near by, moving silently, 10 or 15 feet above the ground, through the willows and aspens.

The second nest was $4\frac{1}{2}$ feet above the ground, supported against the trunk of a living aspen, 4 inches in diameter, by some dead willow limbs on which it rested. The site was at the margin of the stream, and the nest was exposed to the east. The 4 eggs were being brooded by an adult which did not leave until I stood 3 feet away, when it hurried downward and off. An old nest was seen 20 feet away in a willow by the stream. Two of the eggs hatched during the day on June 20. Down on these young was black or grayish black and very sparse.

The third nest, at 7900 feet, halfway between the creek and a trail which marked the edge of the aspen grove, was 9 feet above the ground on a leaning willow trunk 4 inches in diameter. This was surrounded by large aspens with a thick undergrowth of willows 20 feet high. Hence the site was completely shaded. When a small mirror was held directly above it, the brooding bird would not leave the nest and 4 eggs. After I had pounded the trunk of the tree, the bird flew off and downward, perching near the ground before finally leaving toward the stream.

At 8000 feet a nest containing 4 eggs was found 15 feet from the ground in a small, recently killed aspen about 25 feet tall. The tree was in a close stand of aspens and 35 feet inside the margin of the grove. An old nest of this species was seen 10 feet away and 5 feet up in another aspen. The outer

part of the nest was composed of aspen, willow, and sage-brush twigs; the inner part of grass and plant fibers. The lining was of light brown rootlets. Measurements were as follows: inside diameter 65 mm., outside 150 mm., inside depth 50 mm., outside 85 mm.

On June 18, 1931, in Mohawk Cañon a hermit thrush was disturbed from a nest containing 4 small young. The nest was large and bulky; it was 3 feet above the ground, supported between a live aspen and a broken stump close to it.

Half an eggshell that had hatched normally was found, at 7000 feet, along the trail up North Twin River on June 21, 1933. Evidently the parent bird had disposed of it in flight over the trail.

On June 21, at 7700 feet, along the same stream a nest was found 6 feet up on the trunk of a willow 30 feet high. The site was fairly well shaded and was at the margin of an area of aspens and willows in rather an open stand. The nest was bulkier than usual, but it was well-supported. The bird brooding the 3 eggs stayed on the nest almost until it was touched.

Another nest in a small grove of aspens at 8000 feet was in the crotch of a sage bush, its rim only 2 feet above the ground. The rim, inside, measured 77 mm.; outside, 180 mm. Depth, outside, was 120 mm. The outer part of the nest was mainly the dead flowering stems of sage. The inner part was made of shreds of bark, rootlets, grass stems and black horsehair. Three eggs made up the set. When I came within 3 feet, the brooding bird left and flew off silently.

A third nest found on this date was 5 feet above the ground in the dead branches of a willow clump at a crossing of the stream near 7500 feet. It was newly constructed but empty.

This last one and several of the other nests seen were at places where the trail crossed the stream. Others were at or near the margin of aspen woods. Apparently, this bird requires an open view at its nest site. However, with 1 or 2 exceptions when the bird may have been off the nest, all of the brooding birds showed a marked reluctance to leave. Most of them permitted approach close enough to touch them before starting. Then they usually dropped to a perch near the ground and moved away quietly.

A nest found June 24, 1930, at 7500 feet near Birch Creek was 3 feet from the ground in a 5-foot sage bush. This was on a slope 15 feet from the margin of a grove of aspens which bordered a stream. The bush was on a northwest-facing slope where it was exposed to the sun for nearly the full day. Near it were grass, herbaceous plants, and *Symphoricarpos*. The brooding female when disturbed flew to the shade and perched on a branch in the lower part of an aspen. In the nest were 3 well-feathered young and an unhatched egg. Failure to hatch might possibly have been an indicator of an unsuitable nesting site. The nest was constructed mainly of fine weeds stems and grasses, and by that time it was flattened and had a considerable amount of excrement on its rim.

A young hermit thrush just out of its nest was caught on June 29, 1931, among the mountain mahoganies in Mahogany Cañon.

Hylocichla ustulata almae Oberholser

The lower parts of cañons particularly on the east side of the mountain range were inhabited by the Alma thrush. The cañon of Kingston Creek, below 7000 feet seemed to be the most suitable. At least 4 males were found along 1 mile of the stream. It was estimated that not more than 5 pairs inhabited this stretch. Every place where one was noted definitely was at a point in the valley where the belt of trees was a little wider than usual. All that were detected were singing. Almost all the singing birds were heard early in the morning or late in the afternoon. They sang from perches in the shade beneath the dense canopy of the birch tops and close to the stream. They were markedly wary and usually ceased singing and slipped off quietly through the trees when approached. Two males were obtained, June 18, 1930, each with testes 9 mm. in length. Weights were 29.6 and 33.1 gm. Others were shot but were lost because they dropped into the stream.

On May 23, 1932, a thrush thought to be this species was seen and heard uttering single notes next to the stream in the upper part of the gorge of Last Chance Creek at 6800 feet. This one came near me in response to squeaks even though it was across the roaring stream. Hearing in these birds must be remarkably acute to enable them to slip away so easily when a person approaches.

Sialia currucoides Bechstein

Mountain bluebirds occurred in small numbers throughout the Toyabe Mountains and down to the floor of the lowest valley in the area. Presence of suitable cavities for nests seemed the most important factor in determining numbers of this bird. Sites that could be used were remarkably few and far scattered. An additional requirement of these birds was open ground where they might seek food and perches far enough above the ground and sufficiently in the open to serve as lookout perches.

Usually pairs of this bird were seen, but occasionally single individuals were observed. One was noted, April 29, 1930, near South Twin River, in flight with a flock of small birds of another species. On May 1 in the same neighborhood a male and 2 females were seen together along a fence. They perched on posts and flew to the ground where they caught insects. A single one noted, May 20 and 21, 1933, in Smoky Valley, 5 mi. SE Millett, was perching on many fence posts, making short flights to the ground to get food, and each time returning to the top of the same or another post. This was evidently a wandering individual for none was seen here during several weeks before and after this time. A pile of bluebird feathers among aspens at 8000 feet near North Twin River on June 21, 1933, indicated where some predator had eaten one of these birds. On August 30, 1931, several bluebirds were seen near Birch Creek, 7500 feet, in tops of chokecherry trees which were loaded with ripened fruits.

On June 11, 1930, a pair of bluebirds was watched among dead limber pines at 9500 feet on the west side of Bunker Hill. The female postured, quivered the wings, elevated the tail slightly, and gave screechy calls. The

male came and perched beside the female, but only for a moment, and then left.

On May 30, 1930, a pair of mountain bluebirds was seen on the tops of piñons at 8000 feet on the north wall of Ophir Cañon. Near by in a hole close to the top of a piñon stump 3 feet high, Lamb found a nest containing an incomplete (?) set of 3 eggs. No bird was on the nest when it was found. The nest was a bulky structure of grass stems, in a cavity barely large enough to permit inserting a hand.

Beneath the roof at the corner of a house at Millett a cavity containing a bluebird's nest when examined on June 5, 1933. The nest was composed of grasses and lined with a few chicken feathers; it held 6 eggs. Both adults were present, and they flew about excitedly or perched on a telephone pole 25 feet away.

A nesting pair was discovered, June 11, 1930, at the lower margin of the limber pines on Bunker Hill (Miller). The pair had a nest in an old flicker hole in a dead pine trunk. The material in the nest was entirely grass. It was placed on some snags within the hollow. Several layers of weathered nesting material indicated that the hollow had been used by bluebirds for at least 3 seasons. The nest rim was even with the lower margin of the hole so that as the female sat on the nest, its head projected from the opening. The male joined the female soon after it left the 2 fresh eggs in the nest.

Near Mohawk R. S. on June 17, 1931, a female was flushed from a nest containing young. The opening of the cavity was 4 feet above the ground and on the east side of an aspen trunk. Young birds in the nest were heard calling.

Beginning June 20, 1930, nesting mountain bluebirds were observed at Birch Creek, 7000 feet. The nest was in a cavity made by flickers in the side of a house. At first the birds were markedly timid and flew away whenever a person came near them. By the second day the female would enter the nesting cavity while being watched. By the third day the female would cling to the entrance while a person stood 15 feet away. Several times the bluebirds were seen pursuing a flicker which happened to come near the cabin. The contents of the nest were thought to be eggs or small young. At 3:30 a.m. a bluebird here was heard singing a faint erratic warble.

Myadestes townsendi (Audubon)

The Townsend solitaire was observed in the mountains on 3 occasions. On April 30, 1930, at the mouth of the cañon of South Twin River, 6500 feet, several small groups of 3 to 5 birds each were seen in the tops of trees near the stream and on rocks on the side of the cañon. One was heard singing. On May 2, another individual was seen along the cañon wall close to this camp.

In late afternoon, June 18, 1930, a solitaire was heard (and shot) giving the single bell-like notes from the top of a dead cottonwood close to Kingston Creek at 7000 feet.

The 3 specimens obtained were all males. Two were from South Twin River, 6500 feet, April 30 and May 1, 1930. The third was the one mentioned above from Kingston Creek, June 18; length of testis was approximately 9 mm.

Polioptila caerulea amoenissima Grinnell

The western gnatcatcher was a sparse summer resident on lower parts of the mountains; recorded twice. A nesting pair was obtained, June 20, 1930, near the mouth of Kingston Creek, 6200 feet (Miller). These birds were on a steep hillside covered with piñons, junipers, and sage brush near the eastern base of the mountains. The male was heard singing at a distance of 75 yards. While the pair was being watched, the female went onto the nest, and the male continued to sing from the dead top of the nest tree—a piñon. The male moved about to feed, going as far as 70 yards from the nest. At these times it gave call notes but did not sing. The song was given only within 50 feet of the nest. As the female settled onto the nest a Clark nutcracker appeared on top of a tree 20 feet away. The male at once moved into this tree, perched within a few feet of the nutcracker, and gave the mewing call note. The nutcracker moved on, however, without further disturbing the gnatcatchers. The nest was saddled among a clump of live twigs of the piñon, near the end of a horizontal branch, 8 feet from the main trunk and 4 feet above the ground. The brooding female remained on the nest until the twigs within 1 foot of her were touched. The nest contained 4 eggs that were well incubated.

On June 5, 1932, a western gnatcatcher was watched in cottonwoods and birches close to the southern fork of Wisconsin Creek, at about 7000 feet (Orr).

Corthylio calendula cineraceus Grinnell

Ruby-crowned kinglets were observed to be common transients in the lower parts of the mountains and in Smoky Valley. At 5 mi. SE Millett, this bird was noted on April 26, 1930, and May 16, 1932. Many were found April 29 to May 12, 1930, along South Twin River, 6500 to 7000 feet. They were in piñons, birches, and willows. On Ophir Creek, 6500 feet, several were seen May 18, 1930, in willows and birches. On May 22, 1930, one came in response to excited chirpings of bush-tits near their nest near Wisconsin Creek, 7500 feet.

One record indicates that this species remains to nest on the Toyabes. On June 20, 1933, at 4:30 p.m. a singing male was discovered among limber pines above 10,000 feet, on the divide between North Twin and South Twin rivers.

Anthus spinoletta rubescens (Tunstall)

The American pipit was a transient, noted in the spring. On May 8, 1930, several pipits were found feeding in an alfalfa field near Twin River at 6000 feet. A female was collected from this flock.

Bombycilla garrula pallidiceps Reichenow

The Bohemian waxwing is included here on authority of Bailey (MS)

who on November 15, 1890, obtained 2 specimens (nos. 137926, 141853, U.S.N.M.) from a flock of 8 feeding on rose haws on the bank of Reese River, 30 mi. S Austin. The next day a flock of 9 stayed around the same place most of the day.

Bombycilla cedrorum Vieillot

The cedar waxwing was a transient, observed on 2 occasions in spring.

On June 3, 1930, a flock of about 8 cedar waxwings was seen in flight and perched in trees along the road near the Smithline Ranch at the mouth of Kingston Cañon, 6000 feet. Again, in midmorning on June 7, 1932, another flock of 8 birds was seen in flight toward the north, over the marshy part of the valley, 5 mi. SE Millett.

Lanius borealis invictus Grinnell

Bailey on November 22, 1890, obtained a female northern shrike (no. 141721, U.S.N.M.) on the Reese River.

Lanius ludovicianus nevadensis Miller

In Smoky Valley we learned to look for nesting loggerhead shrikes in a rather narrowly restricted type of habitat. Apparently the chief requirements of this bird in this area were for bushes to serve as lookout perches and open ground that could be surveyed for food. The bushes were not necessarily tall ones nor ones completely isolated. Scattered groups of bushes were suitable so long as some open ground was accessible from them. Nature of the soil seemed to make little difference so long as there was some vegetation but not too dense a cover. Presence of plants was necessary if there was to be insect food, but too much cover would tend to conceal the prey. Within the occupied territory the highest perches available were likely to be the ones most often used.

Apparently in this region abundance of food was significant among the factors controlling the presence and numbers of shrikes. My impression was that 1933 was the most favorable year of the series spent here, for foraging by shrikes. I would have expected shrikes to obtain their food more easily that year than the others. That this was the true condition was indicated by an increased number of shrikes noted that season compared with previous seasons spent on the same ground. However, even with the comparatively favorable conditions each pair seemed to require a large territory. Nests were at least half a mile apart in each direction, even on the most crowded area.

That shrikes in this desert region bathe was suggested early in the morning of April 22, 1930, when one was seen perched in a willow at the side of a stream, preening and drying its feathers. Later the same bird was perched in the top of a bush in pasture land. This was in Smoky Valley, 5 mi. SE Millett.

Response to the presence of another species was noted in midafternoon of June 8, 1932, when a shrike was watched as it perched in the top of a buffalo-berry bush in Smoky Valley. A kingbird which had a nest near by came and perched on top of the same bush; the shrike meanwhile dropped

to a more protected perch about a foot lower. A moment later when the shrike flew away, the kingbird followed it.

The stage of development of gonads was noted in 2 shrikes shot near each other in Smoky Valley on April 26, 1930. In the female the ova were still small. In the male the testes were 6 mm. long. A male shot on April 24, in the same neighborhood had somewhat smaller testes.

A nest was found at noon on May 28, 1933, in Smoky Valley, 5 mi. SE Millett. The site was 4 feet above the ground in a small dead buffalo-berry bush at the margin of a small, scattered clump of those bushes standing on the western margin of a large, open pasture. The nest was nearly completed, and part of its lining was in place. Both birds of the pair were present, one of them being at the nest. When this nest was visited at 5:45 a.m. on May 30, it contained 2 eggs. At 4:20 p.m. there were 3 eggs. At about 8 a.m. on June 4 there were 4 eggs and an adult was brooding. It left the nest when approached within 10 feet, but soon returned and went onto the nest while a person stood within 20 feet of it. Its mate remained perched on another bush 20 feet from the nest.

Hatching at this nest began on June 15. At 5:50 p.m. 1 young bird had just hatched. The brooding bird flew off when I came within 10 feet. Then both parents perched in dead tops of buffalo-berry bushes 30 and 60 feet away. One of them uttered alarm notes. There were 3 young in this nest at 6 a.m. and 1 p.m. on June 16. The fourth one hatched before 6 a.m. on June 17.

Another nest in Smoky Valley east of Rogers contained 1 egg when found on May 29, 1933. It was about 4 feet above the ground in buffalo berry. One bird was on the nest, and its mate perched on a bush 50 feet away. This nest held 6 eggs when examined on June 10. At this visit 3 adult shrikes were seen perched in 1 bush, about 100 yards from the nest. These were thought to be the 2 owners of the nest and an intruding male. At least one of the birds was singing: All of them remained in the bush for about 4 minutes. Then 1 bird drove another from the bush, but did not chase after it. The latter went about 40 feet to another bush where it remained unmolested. The pair then moved near the nest, and the male sang for about 3 minutes. The intruding bird disappeared, but it could be heard singing not far away. The female returned to the nest about half an hour later. None of these eggs had hatched when the nest was visited on June 16.

A nest was found, June 7, 1933, $\frac{1}{4}$ mi. N Rogers, by watching the male gathering insect food which it carried to the female on the nest. During 2 hours in early morning that this bird was watched it foraged both for itself and the brooding bird. The nest was $2\frac{1}{2}$ feet from the ground on the lower branch of a buffalo-berry bush. A wild-rose bush was intermingled with the buffalo berry and helped support the nest. The materials in the nest were mainly twigs of buffalo berry, rabbit brush, and sage brush, and items like cotton, rabbit fur, grass, and horsehair. The lining was of white horsehair and rabbit fur. Four eggs had been laid when the nest was found. On June 11 there were 5 eggs.

On June 14, 1933, a nest containing 5 small young and a sixth in process of hatching was discovered 1 mi. E Millett. The site was 18 inches above the ground in the northeast part of a wormwood bush. Materials in the nest were twigs of wormwood and sage with a lining of plant fibers and a small amount of wool. The bird at the nest flew off when a person approached within 20 feet. It was fed by its mate twice within a few minutes. During this feeding both birds perched on a wire fence. The newly hatched young were completely bare; no trace of down could be detected.

Near South Twin River, 6000 feet, close to the upper rim of Smoky Valley, a nest was found on June 5, 1933. It was 3 feet above the ground in a 4-foot sage bush standing on the bank of the stream, 4 feet from water. The nest was supported in the main crotch of the bush, was composed of gray sage twigs, and was lined partly with rabbit fur, partly with shreds of bark. It was partly shaded by the bush. Measurements at the rim were as follows: inside 9 cm., outside 14 cm. Five eggs made up the contents. When the nest was discovered, an adult (female) was perched in the top of a wild-peach bush 30 yards downstream. Its mate came with a grasshopper which it gave to this bird after it had begged. The food was taken to the ground and eaten, and then both birds left.

Beginning June 6, 1933, observations were made in another shrike territory SE of Millett. At first 2 individuals were seen at a patch of dead brush. One appeared to be trying to drive away the other which soon left and flew $\frac{1}{4}$ mile to the southeast. A single individual was seen in this area 3 times on June 12. The nest was found on June 16 when the brooding bird flew off but returned after a minute in the main perching bush. It was 3 feet up, on the southeast side of a dead, fallen buffalo berry which made a thicket 6 feet high and 15 feet in diameter. The materials on the outside were mainly twigs of buffalo berry and shreds of other plants. The lower half of the lining was brown (or red) cow hair, the upper half plant fibers and wool. Color of the outside of the nest was the same as of the bush which provided the support. Six eggs made up the set.

After the nesting season, shrikes both young and old tended to wander to the mountains. On August 16, 1932, 2 young females were taken along Big Creek at 6700 feet. An adult female was obtained on the meadow at Birch Creek, 7000 feet, on August 30, 1931.

Lanius ludovicianus gambeli Ridgway

This transient shrike is represented in the Toyabe collection by the skin of an adult female, obtained on August 15, 1932, at 8000 feet on Big Creek.

Vireo solitarius cassinii Xantus

The Cassin vireo was found in the Toyabe region only as a transient. Occurrences were recorded at Birch Creek, 7500 feet, on August 31 and September 2 and 3, 1931, at Kingston Creek, 6500 feet, on September 4, 1931, and in Smoky Valley, 5 mi. SE Millett, May 22, 1932.

Vireo gilvus swainsonii Baird

In the Toyabe Mountains the warbling vireo was one of the common

species, widespread wherever there were deciduous trees. It was of regular occurrence in the groves of aspens and cottonwoods. The favorite habitat was in trees 25 to 30 feet high where there was some undergrowth and leaf-litter. But the birds kept closely within the crown foliage. This was the most numerous species in the birches and willows which lined the streams. It occurred also, but less commonly, over the ridges in mountain mahoganies. Chokecherry thickets provided suitable homes, especially when in fruit in the fall. Individuals were seen a few times in piñons. The most unusual habitat of this species in the mountains was illustrated on June 14, 1930, when one was singing in bushes of *Symphoricarpos* on an east-facing ridge at 8600 feet near Kingston Creek. The nearest trees were mountain mahogany, 200 to 300 yards distant. The bird may have been stationed there only temporarily, but it was singing.

The only summer record for the floor of Smoky Valley is of a singing bird noted June 8, 1934, in a willow thicket 5 mi. SE Millett. This bird, too, may have been stationed here only temporarily.

Our observations indicated that warbling vireos arrived in spring first near the base of the mountains and moved to higher altitudes as the trees came into leaf. In 1930, the species was first noted on May 24 at 8200 feet, where aspens were just coming into leaf. First records in 1932 were at 6500 feet. In 1933, vireos were seen on May 26, up to 7000 feet. They were a little above where the trees were leafed out. Our latest fall record was at Kingston Creek, 6500 feet, on September 4, 1931.

At 8000 feet in Mahogany Cañon a partly completed nest was found on June 11, 1930. It was 8 feet above the ground in a chokecherry near the base of a rocky cliff. The near-by vegetation was mainly mountain mahogany with birches along the stream which ran 15 feet away. One side of the nest hung from a twig and was unattached to a similar, but less extensive, piece evidently representing the opposite side. No connecting material was seen. About 6 inches below the nest a wisp of material was fastened to a limb, indicating that a false start had been made at nest-building there. One bird made 2 trips to the nest within 15 minutes. Another was in constant song within 50 feet of the nest and once sang within 5 feet of it (Miller).

Another nest, apparently new and complete, was seen, the same day, 15 feet above the ground in an aspen in the same vicinity.

On June 18, 1930, a nest which looked like a newly built one of this species was seen 15 feet above the ground in a birch clump. The location was on Kingston Creek, 6600 feet.

On Mohawk Creek, June 20, 1931, a nest was found 9 feet above the ground in an aspen. It was on the north side of the tree on the north side of a clump. The nest was well shaded, but it was plainly visible from below. In it were 3 eggs and a young bird that had just hatched. Both parents were near and they scolded anxiously.

Vermivora celata celata (Say)

Specimens of orange-crowned warbler obtained in the fall migration were

identified as belonging to this race, as follows. Birch Creek, 7000 feet, September 1, 1931; 5 mi. SE Millett, September 8 and 10, 1931.

Vermivora celata orestera Oberholser

The Rocky Mountain orange-crowned warbler was a transient and summer resident in small numbers. During the migrations there are records for Smoky Valley, 5 mi. SE Millett, May 23 and 24, 1933, and September 8, 1931. On South Twin River, 6500 feet, near the base of the mountains specimens were obtained, May 9 and 16, 1930. These transients were in willows and buffalo-berry bushes.

Higher in the mountains, birds found near Birch Creek, 7300 to 7600 feet, were doubtless part of a nesting population. Adult males were obtained on June 23, 24, and 25, 1930 and August 31 and September 2, 1931. On Kingston Creek one was taken, August 17, 1932. All individuals in this locality were in the groves of aspens.

Vermivora celata lutescens (Ridgway)

The lutescent warbler was a transient, recorded from the Toyabe Mountains only in the fall. Specimens from Birch Creek, 7000 feet, August 31 and September 1, 1931, and Kingston Creek, 8000 feet, September 6, 1931, appear to belong to this race.

Vermivora ruficapilla ridgwayi van Rossem

The Calaveras warbler was a transient, represented by 2 specimens, male and female, shot September 2, 1931, in groves of aspens on Birch Creek, 7500 feet.

Vermivora virginiae (Baird)

The drier ridges at middle altitudes in the Toyabe Mountains provided home sites for Virginia warblers. No adequate appraisal of numbers of this species was obtained. In the first place these steep barren ridges were not easily accessible, and there was a tendency to slight them in our bird watching. Also, the bird is inconspicuous in sufficient degree to make small numbers easily overlooked. This species then is probably much more numerous in the mountains than our records show.

General characteristics of the habitat chosen by this warbler are indicated by the following extracts of notes that were applied to occurrences of the bird or to places where individuals were seen: In sage on rocky, piñon-covered slope 100 yards from a stream; in sage on top of ridge; at tip of mountain mahogany tree; in plum thicket; singing and foraging through upper foliage of tall birches close to creek; in cottonwoods and piñons close to creek; singing in dead shrub 10 feet high at base of rock slide; in aspen; in thickets of sage, elder, *Ephedra*, and *Symphoricarpos*; in willow; on ground among rocks at crest of ridge.

Altitudinally our records of Virginia warblers ranged from 6500 feet to 8000 feet, with the largest number between 7000 and 7500 feet.

Near Wisconsin Creek at 7500 feet a Virginia warbler was watched on

June 3, 1932, beginning at 9:30 a.m. It was singing in a dead shrub 10 feet high at the base of a rock slide close to the creek. The song varied from 7 to 10 notes, being usually 8, and it occupied about 3 seconds. At the beginning the notes were slow and they came more rapidly at the end. About half a minute elapsed between songs. The bird moved about over the northern cañon wall.

The next morning, at 8:15 a.m., a male was seen foraging and singing in the top of a mountain mahogany. It then flew to another tree of the same kind where it perched and sang for about 2 minutes. The whole body and especially the tail quivered with each song. The singing tree was 50 feet upslope south of the creek. Next the bird flew about 25 feet into the air after a flying insect and returned to the ground. Then it flew 50 yards downstream to a group of aspens where it resumed its singing. This bird sang 14 times in 3 minutes and 10 seconds during which time it moved back to the first locality. There were 5 songs in the first minute. Next it flew 50 yards upstream and sang, in turn, from the top of an *Amelanchier*, a mountain mahogany, and the tip of a piñon. The area thus moved over was a strip 100 yards long, and not quite so wide, on both sides of the creek. A bird was singing at this location at 2:30 p.m.

Singing perches on dead limbs that were rather exposed were the rule, but they were not often as high as the tops of tall trees. Foraging seemed to be done as often on the ground or among rocks as in the foliage of bushes, tall shrubs, or low trees.

On June 16, 1930, near Kingston Creek, 7500 feet, a singing male was followed for an hour, beginning at 7:30 a.m. It sang about every 30 seconds. The territory over which it moved was surprisingly large, estimated as extending 400 yards along the cañon slope and vertically about 150 yards, from near the stream to the base of broken cliffs. The area was covered with mountain mahogany, with some scattered sage brush. A few areas of bunch grass were included. The next day another singing male was watched on a comparatively barren, hot, south-facing slope of the main cañon. The vegetational cover consisted of scattered mountain mahogany with small stunted birches and sage brush, with large expanses of rocky talus slope. The song, compared with that of the Tolmie warbler had a more rapid rhythm and the notes were thinner and weaker. It could be distinguished from that of the Audubon warbler by the lack of rising inflection at the end. The song was represented by the observer (Miller) as zdl-zdl-zdl-zdl, zt-zt-zt-zt.

A nest found June 15, 1930, at 7700 feet, west of Kingston R. S., was at the lower edge of a clump of grass 20 inches tall and 2 feet across. The surrounding hillside was of small rocks lying at a maximum angle of rest. A few similar grass clumps were scattered near, about 10 feet apart. The surrounding trees were mountain mahogany and chokecherry. The nest was composed entirely of grass and was in a depression in the loose soil. It was well concealed by dead grass at the base of the tuft. The brooding female flushed as a person climbed the slope below it and slid in the gravel.

It flew off when he was 10 feet away and flew down the hill. The female would not come nearer than 50 feet while the observer stood near the nest. It mostly stayed low in the trees and bushes, frequenting a patch of choke-cherry principally. After this bird was shot the male appeared, but it was even more shy and could not be approached within 50 yards. The nest and 4 eggs were preserved along with the female (Miller).

Dendroica aestiva morcomi Coale

Most of the yellow warblers in the Toyabe region spent their summers in the valleys on either side of the mountain range. A few, however, found suitable surroundings on the meadows and along the streams on the lower slopes of the mountains. These suitable surroundings were nearly always made up largely of dense, rather tall thickets of willow and rose along with the other kinds of plants usually associated with these. It happened that these thickets often grew close to open water, but apparently this was not part of the requirements of the birds, for they lived in the thickets at some places where the ground was only moist, and even where it was completely dry. In the main, though, the moisture was necessary for growth of the plants, and our observations led to the general impression that food supplies for insect-foraging warblers were more abundant in this type of habitat than in the drier situations.

Seasonal records at 5 mi. SE Millett showed the approximate time of residence of this bird in the region. First records for 3 years were as follows. May 13, 1930; May 15, 1932; May 18, 1933. A specimen was obtained as late in the fall as September 9, 1931, at this locality.

Earliest indications of actual nesting were noted on May 24, 1933, when a female was seen carrying nesting material in flight. Another was noted in the same vicinity on May 29, and the basal part of a nest was discovered in a willow thicket. Something happened at this site before June 3, when the shrub had been bent, and no more material had been added. Evidently the birds had gone to some other site.

On June 6, 1933, at a dried up pond where there were extensive rose-willow thickets, a pair of yellow warblers was noted, and a nest was found 4 feet up in a willow 6 feet high, surrounded by rose. The site was on the east side of the thicket, and it was discovered by flushing the female from the nest at noon. The nest was only about 1/3 completed. It was not examined closely for fear of causing the birds to desert. It was composed of whitish materials. Another nest, of a previous year, was seen in a near-by rose bush. On this date there was no water in the vicinity, but the pool had dried within a week. On June 11, this nest was nearly complete but empty. Early the next morning it held 1 egg. At 10:30 a.m. on June 16, the female was brooding 3 eggs of its own and 1 of a cowbird.

At a small marshy area in Smoky Valley a nest was found June 7, 1933, on the east side of a rose-willow thicket. It was 5 feet above the ground in a rose bush 7 feet high. The nest was supported on the main stem by small twigs and was composed of gray fibers. It was shaded. The nest was com-

plete or nearly so but empty. On June 10 the nest was still empty, but on the afternoon of June 15, it contained 4 eggs.

A pair of yellow warblers was watched between 8 and 10 a.m. on June 7, 1932, whose interest was centered in bushes on the north side of a pond. The female was seen mostly in 3 separate clumps of rose and 1 of currant. The male was in the same bushes and also in willows. Twice it made circular flights over a pond where it caught insects over the water. It sang frequently. Often a twittering was heard which seemed to be made by the female. Neither bird was seen to carry anything in this period. At 10:20 both birds flew from 1 currant bush to a perch in the edge of another 1 foot above the ground. The female was facing the male, twittering and waving its wings. Then, apparently, the male fed the female and left. Immediately afterward the female rubbed its bill on a twig on which it perched and then moved to the interior of the bush. Later the nest was found in a rose bush where the female had gone several times. The nest rim was 5 feet above the ground. Three eggs there evidently constituted an incomplete set, for no bird was seen actually on the nest.

At 8:40 a.m. the next morning, June 8, the female was brooding 4 eggs, and when approached within 2 feet, it flew off 15 feet to another bush. Notes were heard, earlier, near the nest which indicated that the female was being fed by its mate.

Dendroica auduboni memorabilis Oberholser

During the nesting season Audubon warblers in the Toyabe region were limited to the mountains. At other seasons they were likely to be seen anywhere in the area. Because our stay in the region was too restricted, extreme seasonal limits of occurrence of this bird could not be determined.

In the mountains the area occupied by this warbler agreed fairly well with the area covered with trees. Individuals were seen most often in aspens, limber pines, birches, willows, and mountain mahoganies. Although most of their activities took place in the middle or upper parts but not the tops of the trees, sometimes they came down near the ground and even went out among the bushes. When frightened in such places, the birds ordinarily would fly to tall trees.

On warm days it was noted that the warblers stayed higher in the trees than when it was cold. Also when the air was warm, they regularly flew into the air and captured flying insects. Foraging on the ground was noted a few times. During a shower of rain about noon on June 4, 1932, an Audubon warbler stayed in a piñon pine while a person (Orr) stood beneath the same tree. As soon as the rain ceased, the bird flew away.

Near Kingston Creek, on June 12, 1930, a female was seen begging from a male, after which the two chased about through mountain mahogany trees. In the same vicinity, on June 16, a male was seen and heard singing among piñons. The songs came at about 20-second intervals. The bird traveled at least 150 yards in 1 direction.

A foraging pair of Audubon warblers was watched on June 24, 1930,

near Birch Creek at 7500 feet. The birds moved actively through a birch in a grove of aspens, spending most of the time toward the tips of the upper branches. Once the male pursued the female in rapid flight, but the branches obscured the view. When the female, in foraging, left the birch, it moved to near-by aspens. It came to the dead tree which held a nest of a broad-tailed hummingbird, moved along the limb to the nest, and peered into it. The warbler then moved closer and made a move as if to peck the single egg in the nest, but checked itself, as if it had discovered the mistake, before the blow was actually struck. It then moved off to another tree.

On June 26 at 7000 feet along this same stream a nest was found 20 feet above the ground on a leaning stem of birch. Five young warblers in the nest were nearly ready to leave. The female was near and it exhibited much concern.

A nest was found, June 20, 1933, at about 8500 feet near North Twin River. It was 10 feet up, in a crotch of an aspen with a trunk 8 inches in diameter and 40 feet high. The tree was 30 feet from the stream. The nest was grayer than the trunk of the tree. It was lined with feathers and held 5 eggs. The brooding female moved off slowly when a mirror was placed within 1 foot of her.

Dendroica nigrescens (Townsend)

The black-throated gray warbler was one of the few species adapted to occupy the piñon belt on the Toyabe Mountains. Not only did this bird tolerate conditions on dry slopes, but it was practically limited to them. The pairs were scattered far apart, but because this type of habitat takes up so much of the total area, this warbler must rank high among all the summer resident birds on the basis of numbers.

Near Wisconsin Creek, June 2, 1932, an individual was heard on a piñon-covered ridge. It moved from tree to tree singing 3 or 4 times in each and staying for about 2 minutes. While it was watched, it went to the top of the ridge and back to the bottom. In the same vicinity at noon on June 5, one that was foraging in sage brush, flew to the top of a piñon where it perched on a cone for $\frac{1}{2}$ minute and then flew off toward the bottom of the cañon. Another individual on June 3, foraged through 4 trees in 15 minutes. This bird was seen often in company of bush-tits, chickadees, or Virginia warblers. Much foraging was done in the bushes, but always these were interspersed among trees.

During the migrations black-throated gray warblers were found in a greater variety of situations than in summer. The only one seen, on September 2, 1931, near Birch Creek was in an aspen. At Kingston Creek on September 5 and 6, several were found with warblers of other kinds in mountain mahoganies. In spring, on May 19 and 23, 1933, several were seen in Smoky Valley, 5 mi. SE Millett, in willows and buffalo-berry bushes.

Dendroica occidentalis (Townsend)

An immature male hermit warbler was shot, August 31, 1931, near Birch Creek, 7500 feet. The bird had been foraging through a grove of aspens

and birches along the stream. Another individual was seen in aspens in the same vicinity on September 2. On September 5, 1931, a hermit warbler was seen near Kingston Creek, 7500 feet, with a large flock of migrating warblers in mountain mahoganies and birches.

Oporornis tolmiei (Townsend)

Tolmie warblers were rather common summer residents in a narrowly restricted habitat in the Toyabe Mountains. They lived almost entirely in the low close-growing thickets which bordered the streams. Some of the foraging, probably most of it, took place in the bushes. The habitat of this bird extended mostly over the same ground as that of the fox sparrow, although each bird made its own use of the vegetation and foraged in its own particular portion. Water was available usually, but not always, within the home range of each individual.

Earliest record seasonally is of two seen May 21, 1933, in Smoky Valley, 5 mi. SE Millett. This species was found in that vicinity in the fall as late as September 9, 1931. All records for Smoky Valley are for transients. One was seen in the mountains as early as May 22, 1930, when a single individual evidently was on its summer ground near Wisconsin Creek, 7000 feet.

On June 18, 1930, a Tolmie warbler came up from a thicket, near Kingston Creek, to drive away a bush tit that had foraged low over it. One showed much concern when approached on June 19, 1930. It was seen twice to fly after and chase away a Virginia warbler. On June 3, 1932, one came in response to alarm notes of house wrens in aspens at 8500 feet near Wisconsin Creek. On June 5, near the same creek, a female came twice in response to alarm notes of Nevada towhees. It kept near the ground in lower parts of sage bushes beneath birch trees.

Close to Kingston Creek, 7000 feet, a nest was found on June 19, 1930. It was in a small sage bush and thistle plant beneath the edge of a large rose bush in a rather open place. The nest was not well hidden and its rim was only 15 cm. above the ground. The brooding bird flushed from the 4 eggs and flew over the bush and out of sight. It did not return during my stay there of about 15 minutes. This bird was still brooding on June 26. When approached, it slipped off quickly over the ground.

On June 22, 1931, near Big Creek, a nest was found 3 feet up, in the tangle of a dead vine beneath the shade of trees close to the stream. In it were 5 eggs, but no bird was seen on that date. At 6:30 the next morning the brooding female flew off this nest when approached closely. It hopped from twig to twig and on the ground in the near vicinity but made no sound.

A nest containing 5 eggs was found, June 24, 1930, near Birch Creek, 7000 feet. It was 18 inches above the ground in a small aspen 3 feet high around which was growing some wild rose. This was at the outer edge of a stand of aspen. Incubation was far advanced (Lamb).

Another nest in this vicinity was found on June 25. It was 2 feet above

the ground in leafy sprouts at the base of a medium-sized birch clump on the bank of a stream. The site was fairly well screened and was shaded for the whole day. On the surrounding ground lay large scattered rocks with a few small bushes and some scattered grass. Twenty-five feet away was dry open ground and sage. The nest held 5 eggs. The brooding female flew off and for a few seconds it flew about shyly with wings partly drooping, and then it withdrew from sight.

Geothlypis trichas scirpicola Grinnell

Yellow-throats lived in summer about the springs and marshy pools in Smoky Valley. They were noted in small numbers 5 mi. SE Millett. Dates of occurrence in spring which probably represented first arrivals in the area are as follows: May 13, 1930; May 17, 1932; May 18, 1933. The only fall record is for September 9, 1931.

These birds were seen nearly always in willow and rose thickets at the margins of the pools. Once or twice one was seen feeding in vegetation over the water. Except that singing males were nearly always accompanied by females through the last half of May and the first half of June, no positive evidence was obtained that the species nested here.

Icteria virens longicauda Lawrence

Only a small bit of the ground in the Toyabe area was of the sort that long-tailed chats inhabit. Accordingly only a few pairs of this species were found during this work. These were in the thickets near the center of Smoky Valley and along the streams close to the base of the mountains. More particularly the birds were seen 1 and 5 mi. SE Millett, on South Twin River, 6500 feet, and near Kingston Creek, 6000 feet. Doubtless they lived at many other locations in the region, but everywhere in small numbers.

Time of arrival in Smoky Valley in 3 seasons is indicated by the following dates of first observation: May 19, 1930; May 16, 1932; May 18, 1933.

The large, dense thickets of buffalo berry, intertwined with willow and rose provided satisfactory home sites for this bird; in Smoky Valley in favorable stretches of a mile 3 or 4 pairs could be detected. Year after year noises made by this bird came from exactly the same spots. Either these were more suitable than other spots which appeared to be similar, or the birds exhibited an especially strong tendency to return to the same bushes. My impression is strong that the latter must be the true explanation. Another characteristic was that individuals seemed not to wander even for short distances from their home sites. This was determined mainly on the basis of the songs which would be heard over and over from perches so close together they seemed to be the same. Songs were heard most often in early morning, but they continued through the day at intervals, and sometimes they were heard at night.

A pair watched on May 16, 1932, was foraging in a small currant bush on the shore of a pond. The male (?) went to the ground twice for periods of not more than 3 or 4 seconds. No sounds were made by the birds while they stayed in the vicinity of the bush and foraged for half an hour. Usually the males (or singing individuals) were in the top or upper parts of bushes

while the mate would keep on a lower level and more closely within the bush. One on May 29, 1932, was imitating a Say phoebe which was calling 150 yards away.

About 1 mi. S Millett, on June 14, 1933, a chat's nest apparently new, but unlined, was found. One individual sang near the nest and another scolded within 2 feet of it. The site was 2 feet above the ground in a dense thicket of rose and willow bushes. The nest was still empty, and, a week later, it apparently was deserted.

A chat was watched, June 10, 1930, along Kingston Creek, below the mouth of the cañon, which was evidently building a nest. It was carrying a leaf, and then it picked up more material from the ground. Carrying this it made a short flight out of sight among the tangle of bushes and dead brush.

On June 20 a nest was found a mile below the location mentioned above. This one was in rather an exposed situation 10 feet away from the streamside thicket and was in a straggly rose growing over a clump of old, dead sage. It was compactly made of grass stems on the outside, next shreds (strips) of bark, and finally a lining of rootlets. The rim was 30 cm. above the ground. Outside diameter was 150 mm. Dimensions at the rim, inside, were 65 by 70 mm. In the nest were 4 young and an addled egg. An adult flushed from the nest when it was first approached and flew away quickly, but soon both parents returned and showed much concern—hopping and fluttering in the bushes and on the ground up to within 3 feet of me and uttering several types of notes. At this time all the young jumped out of the nest.

Wilsonia pusilla pileolata (Pallas)

The northern pileolated warbler was found at many places in the Toyabe region through extended periods both in spring and fall. Localities and dates are as follows. In spring: Wisconsin Creek, 7200 feet, May 25, 1930 and June 4, 1932; ridge near same creek, 8800 feet, May 28, 1930; Summit Creek, 7000 and 6500 feet, May 26, 1933; South Twin River, 6500 feet, May 12, 1930; 5 mi. SE Millett, May 13, 15, and 16, 1930, May 15, 17, 19, 22, 29, and 30, 1932, May 18, 19, 20, 22, 23, and 24, 1933. In fall: Birch Creek, 7000 feet, August 29, 30, and 31, and September 2, 1931; Kingston Creek, 6000 feet, September 4, 1931; 5 mi. SE Millett, September 10, 1931. These transient birds were seen in a variety of situations, but usually they were near water. They foraged in many kinds of plants, including sage brush, willow, aspen, mountain mahogany, birch, buffalo berry, rose, and wormwood. Several times individuals were watched as they flew into the air after insects.

Indications that pileolated warblers sometimes nest in this area were noted on June 9, 1932. At 10 a.m. a male was singing and foraging in tall shrubs in the garden and in cottonwoods near the house at Millett. This bird gave the impression that it was settled on its nesting grounds, but no definite proof of its nesting was obtained.

Passer domesticus (Linnaeus)

Every occupied set of ranch buildings in the Toyabe region appeared to

have a resident population of English sparrows. In Austin they inhabited the store buildings along the main street. In addition to the birds which remained near the buildings we found many which evidently were prospecting for homesites away from permanently occupied buildings.

Especially at the deserted buildings in Smoky Valley, 5 mi. SE Millett did we detect these wandering birds, both singly and in small groups. On May 22, 1932, a male was seen and heard singing in a buffalo-berry bush close to the house there. On June 2, 2 individuals were seen about the buildings. On June 6, 3 birds were present about the buildings all afternoon. The next day 2 males and a female were noticed about 4 p.m. feeding at a trash pile near the house. When a sudden, but not loud, noise was made in the house, one of the birds jumped about 8 inches but settled again and resumed its feeding. Many times during the day 1 or 2 individuals were seen flying from this place off toward the south in the direction of ranch buildings a little more than a mile away. These birds were seen about the buildings here several times on June 8 and 9. Doubtless they had been attracted to this spot temporarily by the refuse from our camp. There was no indication that the place was occupied permanently. Another one was heard about the corral at this place in the early morning of May 26, 1933, but it was not detected again. These instances indicate the readiness with which this bird is able to settle in new locations as they become available, and they help to show how it has been able to spread so widely and so rapidly.

At Millett on June 5, 1933, a nest was examined inside a shed attached to the store building. The nest was inside a stovepipe elbow close beneath the roof of the shed which was kept closed so that the birds' only access to it was over the top of a loosely fitted partition. The brooding adult flew off when we entered the shed. The nest, built of grass stems and lined with feathers, held 5 eggs.

Sturnella neglecta Audubon

Western meadowlarks were numerous in parts of the lower valleys on either side of the Toyabe Mountains. They inhabited especially the alfalfa fields and pastures about the ranches, both occupied and deserted, in Smoky Valley. Where most of our observations were made, 5 mi. SE Millett, meadowlarks seemed to be present where wild rye grew in all parts of the vicinity. At all these places there were scattered clumps of tall bushes, usually buffalo berry. These bushes as well as fence posts and taller trees supplied singing posts the availability of which seemed to play a large part in determining the local presence of the pairs.

It was noticed that these birds were conspicuous and noisy when the sun was shining. Once, in early morning of May 28, 1932, when there was an especially strong south wind, 2 singing meadowlarks kept down within the foliage of the bushes where they were protected from the wind. This made it much harder to see the birds than is the case in quiet weather.

Several instances illustrating encounters that may take place between meadowlarks and other birds were noted. In the midmorning on May 24, 1932, a meadowlark was singing on a bare branch in the top of a tall rose

thicket close to a small pool. When a male red-winged blackbird came near the perch, the meadowlark flew after it and chased it across the marshy pool and back and around the rose clump several times. Both birds then settled on perches 20 feet apart. As soon as the meadowlark left for another singing perch toward the southeast the perch it left was occupied by the red-wing.

During most of the morning of May 29, 1932, a meadowlark sang about a marshy area where yellow-headed blackbirds nested. One of its song perches was the top of a buffalo-berry bush within the nesting territory of a blackbird, but no clashes between the 2 individuals were detected.

The most impressive feature of meadowlark behavior in this area was wariness. Although we obtained little direct evidence here, acquaintance with the species elsewhere leads to the conclusion that it is frequently an item of food for prairie falcons. The birds we watched were constantly on watch, and they slipped away at the slightest disturbance. We noticed this timidity especially in our attempts to find nests—in any place where we were sure one was near. Certain individuals were observed to cease singing when a marsh hawk came into sight, or when red-winged blackbirds gave alarm notes. These notes were somewhat similar to the ones made by meadowlarks on like occasions.

The songs of meadowlarks were conspicuous among the sounds in the inhabited areas. Usually these were given from some rather high perch. One, on the morning of May 25, 1932, sang 22 times in 3 minutes: 8, 7, and 7 times each minute. It then uttered 3 single whistles and moved about 75 yards to another perch where it resumed singing. Another on June 6, 1933, sang 10 times in 1½ minutes; 7 times the first minute.

One type of song was given regularly in flight. The singing bird would rise gradually in a straight line and then drop abruptly. One that was watched flew up 75 to 100 feet, at a 45°-angle, singing on rapidly beating wings, and went down 50 to 75 yards away.

Territories of meadowlarks seemed to be about ¼ miles across. However apparently they often left their nesting territories on long foraging trips. In the morning of May 25, 1932, one was seen in rapid pursuit of another which went to the ground where it remained for more than 2 minutes. The pursuer returned to a singing perch where it sang a few times and then flew off across a pasture.

On June 14, 1933, many meadowlarks were seen about the pastures and grassy places near Millett. One showed much concern when I passed across an area close to the garden, where there were scattered bushes of rabbit brush. Another one, early that afternoon, flew to a grassy patch of ground with its bill full of insects. One was seen carrying food in its bill on May 31, 1932.

Two nests of meadowlark were found in 1932, in a small area in Smoky Valley, 5 mi. SE Millett (Orr). One was found on May 30, by flushing the brooding bird from a nest when it was approached within 20 feet. The nest was in an open part of a meadow, and was built in a depression in the ground, fully 3 inches deep and 8 inches in diameter. It was well covered with a dome-shaped roof composed of fibers of bark and plant stems woven in with

the growing vegetation. The top of the roof was about 5 inches above the surface of the ground. The inside of the nest was globular and $4\frac{1}{2}$ or 5 inches in diameter. The round entrance on the south side was $2\frac{1}{2}$ inches in diameter. The lower margin of the entrance was about an inch below the surface of the ground. The lining was of small grass stems. Four eggs made up the set. When this site was examined on June 7, the nest had been torn up. The top had been pulled off, and the eggs were gone.

In the same vicinity on June 7 a brooding bird flew up just as it was almost stepped on. It landed 2 feet away and ran, fluttering along the ground for 50 feet, disappearing beneath a clump of buffalo berry. The nest was in a sedge-covered meadow where the plants were 6 to 12 inches high. It was in a cavity 6 inches deep with grass-roofed runway about a foot long leading to it from the south. The outer part and a half-hood over the north side were composed of gray, dead grass stems and bits of plants. The inner lining was of small yellowish brown grass stems. This nest held 5 eggs.

Xanthocephalus xanthocephalus (Bonaparte)

Yellow-headed blackbirds nested in small colonies at marshy spots near the center of Smoky Valley. Conditions in this valley were so near the limits of suitability for the species that it was represented in the breeding season by only a few individuals, and these seemed to have great difficulty in carrying the nesting cycle to a successful conclusion. This was partly on account of the small number of sites at all suitable for nesting and the small size of those areas. Added to this was the rapid change, drying out, which spoiled the sites for this bird, often before nesting was well started.

The 2 factors which appeared to operate most prominently in determining the presence and success in nesting of yellow-headed blackbirds in Smoky Valley were, first, standing water and, second, vegetation growing or standing in the water and projecting above the surface to provide perching places and nest support. Cattails were most likely to fulfill the latter requirement although, evidently, other plants might serve. For example, the largest colony studied and the only one observed to reach a stage of having young was entirely in a willow thicket. However, the required water was present. The water evidently served to protect the nesting colony from ground prowling predators, and the species seems to be adjusted to require this protection. The problem of obtaining food seems to have become secondary—in this region, wherever the other conditions are present, the food supply is likely to be sufficient. The vegetation serves additionally as a screen to protect the birds from raids by flying predators.

Dates of first observation, which probably represented time of arrival, of the species at the station 5 mi. SE Millett, for 3 years were as follows: 1930, May 13; 1932, May 14; 1933, May 19.

The first yellow-headed blackbirds noted each season usually were stationed at marshy areas which, later, turned out to be nesting sites. However, they were sometimes merely noted in flight along with other kinds of blackbirds over the drier parts of the area. In 1932, the first bird, a male, was

perched on a post in a corral where it gave calls for a few minutes in late afternoon.

Most of the observations on this species were made at a small pond which held water from the overflow of a spring. This pond was approximately 200 yards long by 100 yards wide; it extended from the southwest, the end connected with the spring, to the northeast. In 1932, on May 16, the pond was nearly full of water and had an area of open water, about 50 feet across, at the north end. A large part of the pond was filled with sedges and a big patch of *Hippuris*. In its deepest part the water was scarcely more than a foot deep. On the margins there were 4 distinct patches of cattail, 3 of them with dead stalks extending above the newly grown leaves of that season. On the shore, near each cattail patch, were thickets of buffalo berry, rose, willow currant, and other shrubs. All these, but especially the buffalo berry, were used as perches by the blackbirds. The pond was not permanently filled, and, each season, it was dry or nearly so before mid-season.

To determine the number of individuals of so conspicuous a bird in a restricted area would seem a simple procedure but, actually, it proved to be most difficult. In 1932, as many as 4 males were seen at the pond at one time, but apparently only 3 of them attempted to establish breeding territories there. Of these only one reached the stage of actual incubation. It was more difficult to see the females; as many as 5 were seen at the pond at one time. Five nests were started that season, and later a sixth one. Six, then, is the figure, arrived at rather arbitrarily, for the number of females present. In 1933, the same sort of difficulties prevented an accurate census of the nesting colony. The final estimate was that 4 males and 8 females were members of the colony long enough to reach an advanced stage of nesting. It was certain that other individuals were present at times.

In the 1932 season 3 males (I, II, and III) apparently had well established territories. The main part of each territory was in a patch of cattails where there were dead stems of a previous year. The numbers are used to designate either the males or the territories occupied by them. Male number I defended the cattail area at the south end of the pond and used for singing posts the clumps of buffalo berry on the shore northwest of the cattails. Number II occupied cattails in the northwest corner of the pond and singing perches on the shore to the southward; it never perched for long in any of the bushes north of the cattails. Those bushes were mainly rose and willow. Number III had an area along the central part of the eastern shore, and it perched in bushes on the shore eastward from there. These 3 males spent practically the whole time, when at the pond, at or close to their own stations. A fourth male was present a few times in bushes on the western shore, between territories I and II.

In 1933 the pond was a little more attractive to yellow-headed blackbirds than in 1932, probably because of the slightly larger extent of the patches of dead cattail. Instead of 1 male at territory III, 3 birds took up residence there. Two of them were in the same cattail patch that had belonged to 1 bird the year before. That these 2 males kept to their own territories could be determined because they differed rather conspicuously in the depth of the

yellow coloration about the head. The 2 males spent much time perched in the cattails, within 1 foot of each other, and they seemed to continue to be friendly. Nevertheless, the dividing boundary seemed to be well established even though there was no conspicuous indicator of its location. The bird farthest out in the pond had no closely adjacent bushes on the shore, as did all the others, for shelter and singing perches. Occasionally, it went to bushes on the southwestern shore of the pond. This species never became settled in territory I and the male that was there early in the season actually took little part in the happenings at the pond in 1933.

Judging from continued watching at this pond through the greater parts of 2 nesting seasons, territory for these yellow-headed blackbirds was a definitely recognized area for males only. Moreover, this area was a remarkably small one, when the size of the birds is considered. Each male established itself in 1 small patch of cattails or a portion of a patch. From this small nesting habitat it ranged out over a part of the pond in 1 direction and, usually, over a small area of shore which included bushes suitable for perches. The distance each bird ranged over the pond seemed to be controlled partly by the presence in other sections of it of other males of the same species. When 1 male was absent, another was likely to make use of the undefended area. At the same time each bird tended to restrict its activities to its chosen cattail patch. These 2 tendencies apparently accounted for the observed size of each individual territory.

From the first establishment of the territories one of the chief concerns of each male was to keep other male yellow-headed blackbirds off his area. The enmity seemed aroused in inverse proportion to familiarity with the trespassing individual. When 2 males owned portions of the same cattail patch, they were much more tolerant of each other than of males from another part of the pond. Newly arrived, strange males arouse a quicker response than ones already settled in the same pond.

As to relation between the sites of particular nests and territory, we were able to detect no facts which indicated that the territory was selected with reference to a subsequent location of any nest. Apparently, the males chose merely areas where some kind of vegetation, in this case cattails, projected a few feet above water. For another colony small willows provided an equivalent attraction.

Besides their vigorous defense against intrusion by other male yellow-headed blackbirds the males were especially active in driving red-winged blackbirds from their territories. The pursuit, however, was usually a short one. In observed instances male red-wings were pursued for only about 30 feet, or just to the limits of the yellow-head territory. If, in leaving, a red-wing crossed the territory of a second yellow-head, the latter would take up the chase and the first yellow-head would turn back. Establishment of nests of the red-wings within or close to the territory of the yellow-headed blackbirds occurred, but doubtless it was possible because the latter were away for a large part of each day, and the smaller birds took possession in this absence.

Once male number III flew across the northern shore of the pond after a male red-wing that had just alighted there. The chase went among the

bushes and back across the pond to the marsh southeast of it where the yellow-head turned back. The pursuer did not come nearer than 4 feet from the red-wing which seemed not to exert itself to escape even though it kept going. Another time a male red-winged blackbird chased a female yellow-head from territory I to territory III; then both male yellow-heads in that cattail patch flew at the intruding male which returned to its own station.

In the 1933 season a male and female yellow-headed blackbird began nesting in the center of a colony of red-winged blackbirds. On June 11, the male was stationed there at 6 a.m. It pursued female red-wings several times and, in turn, was pursued by male red-wings, but they did not drive it from the marsh. It chose perches below the tops of the cattails. When the female lit, it was chased away immediately by a female red-wing, and both were followed by a male red-wing. On June 16, the pair was noted again. Several times, when the male moved, a male red-wing flew at it, but it was not molested so long as it remained perched. On the whole it seemed rather indifferent to these attentions and made no effort to leave the marsh, nor was it seen to retaliate. A nest, 1 foot above the water in a willow near the center of the pond, was about half-finished on that date.

Although the 2 sexes lived on the same area, their use of that area differed conspicuously. Even before nest building began the females and males behaved toward the habitat as 2 separate species. Each female stayed close to the water or the ground and down in the cover of vegetation for the greater share of its time—even when merely perching. On the other hand the males tended to stay on exposed perches in the open except when some special activity required temporary presence at a lower level. On days that were especially windy they hunted the protected sides of bushes and perched there, obviously in an effort to escape the force of the wind.

On several occasions it was demonstrated that males were more closely attached to the area than were the females. When a person came near, the females were quick to take alarm and to fly off, usually in a group. In contrast, each male would fly to a conspicuous perch in his territory and stay there, permitting approach sometimes to within 15 feet, or closer.

Throughout the nesting season each female exhibited an attachment for the immediate site of its nest, but there was little or no indication that the females recognized territory in the same sense as did the males. Females drove off other females which came near their nests. The females, or some of them, moved freely from 1 territory to another, apparently taking no part in territorial defense—possibly not even recognizing the limits of any of the territories.

In early stages of nesting when these birds were watched the territories were occupied for only a part of each day. Many times, 1 or more individuals started up and flew off, high in the air, usually toward the southeast. In that direction there were other small marshy areas. We did not determine whether these trips were made for forage purposes, or whether they resulted from some other cause, such as, possibly, only a lull in the urge to occupy and defend the territory. On some mornings (for example May 20 and 22, 1932) arrival of males was noted after almost an hour spent at the pond during

which no blackbirds were seen. While the birds were at the pond, they varied the intensity of their activity. Sometimes toward the middle of the day the whole pond would remain quiet for half an hour or longer.

No exact records were kept of the share of time spent in feeding at the pond, but, by estimate, about half of each bird's time was spent in searching for and obtaining food. Forage places varied, but nearly all the marshy parts of the pond were explored for food. Both males and females spent much time feeding close to the water among the plants (cattails, sedges, *Hippuris*). A favorite food hunting place was the mud or shallow water close to the shore line. As soon as the air warmed sufficiently for flying insects the blackbirds spent much time capturing the insects in the air. Females flew into the air after insects as often as or more often than did males.

The blackbirds bathed in the pond rather frequently. One male was watched on 2 different days, at 8:40 a.m. and 9:55 a.m., as it bathed and dried its feathers. Once its station was 20 feet from shore and at the edge of a cattail patch. Another time a male was seen bathing at 5:20 p.m. After bathing, the birds usually perched on the cattail stems to dry their feathers and to preen.

The yellow-headed blackbirds were closely associated with few other kinds of birds. However, examples of several rather varied kinds of response to other species were noted frequently. Before actual nesting started both male and female yellow-headed blackbirds were seen in flocks with other kinds of blackbirds. Intolerance of males for males of red-winged blackbirds which came onto their territories has been mentioned already. The procedure was so effective that single pairs of red-winged blackbirds that had established territories and had started to build a nest were forced to move after the arrival of a male yellow-headed blackbird which selected the same territory. In a larger colony of red-wings, though, a single pair of yellow-heads established themselves, and a nest was built without displacing any pairs of the other species. Several times, yellow-headed blackbirds were seen to retreat before the attacks of red-winged blackbirds; these were always at well-established colonies of the latter species. On the morning of June 6, 1933, 3 male yellow-headed blackbirds, apparently first-year birds, came to a colony of red-wings. They were pursued by male red-wings, but they lit in buffalo-berry bushes close by and then they sang. When perched, they were not molested by the red-wings. This applies to males; females normally retreated before male red-wings.

The most frequently observed response to another species was to the marsh hawk. A pair of marsh hawks nested close to the pond, and they flew over it regularly in their daily routine. Once, early in the season (May 16), a marsh hawk made a dive at a female yellow-headed blackbird perched in the top of a buffalo-berry clump. The blackbird immediately retreated down toward the center of the bush. At all other times when a hawk came near the blackbirds, the approach appeared to be accidental. The response of the blackbirds varied somewhat depending mainly on the closeness of the approach. When the hawk merely flew overhead at a considerable distance,

the birds would fly out in a circle, give a high-pitched, rattling call, and return to perch in the top of a bush. If the hawk really came near, the blackbirds usually gave single alarm whistles and hurried to the protective cover of the thorny buffalo-berry bushes. Low chucks were given if the hawk kept on approaching. Less than a minute after departure of the hawk the blackbirds would be out again on exposed perches.

Once a male blackbird actually flew after a marsh hawk but the pursuit was spiritless. Nearly always the yellow-heads showed less concern about the hawks than do red-winged blackbirds. The blackbirds seemed to be more tolerant of other species when a hawk was near. One time a Brewer Blackbird, and another time a red-wing, perched near a male yellow-head without molestation from the latter while a hawk sailed overhead.

When a prairie falcon circled overhead, a male blackbird gave anxious alarm notes and hurried to the cover offered by a bush. At the same time a female flew out from the cattails. They seemed to recognize that woody bushes offered better protection than the cattails.

At the larger colony, on June 8, 1932, when a Swainson hawk flew over, several males gave alarm notes and flew at it. The hawk made 1 dive at a blackbird and proceeded on its way. Later, 2 crows flew over and 2 male blackbirds flew at them and drove them onward.

A single male yellow-head, on June 12, 1933, was perched in its territory in a colony of red-winged blackbirds. When a nighthawk flew low over the pond, it gave alarm notes but kept its perch.

The flight of the yellow-headed blackbirds contrasted markedly with that of the red-winged blackbirds. It was slow and deliberate and seemed to reflect the whole manner of the species. The dull whistle made by the wings could be heard distinctly for 50 yards or farther as the birds flapped heavily from 1 perch to another.

Voice seemed to serve an important purpose in these nesting blackbirds in Smoky Valley. The marshy spots were so small and so scattered that there must have been special need for loud notes to direct attention of unsettled birds to males on nesting territories. The number of notes in the song of the males varied; sometimes it was only 1 drawn out, harsh call. However, the most usual song was composed of 5 notes. The first one was explosive and loud, the next two lower and shorter, followed by 2 long drawn out notes at slightly higher pitch. When the males were at the pond this song was given at rather regular intervals and from habitually used singing perches. These were most often at exposed points where the announcing bird could be seen from, and could see in, many directions. The song appeared to be useful as much to repel invasion by other males as for any other possible service. As an example, on June 7, 1933, after a slight disturbance among the birds on the pond, 1 male flew close to 2 others that were on their singing perches. Both these birds sang, at the same time, as the intruder came near, possibly as a warning not to stop.

One time when 4 males were singing, it was noticed that each one turned its head far toward the left as it finished the song. It was not determined whether this was a habit of the species or only of the 4 males at 1 pond.

Other types of notes were heard, as follows. A series of high-pitched notes, with a few guttural sounds when heard at close range, was given on the circular flight made when a marsh hawk came near. When potential danger first appeared, a plaintive whistle much like that of the red-wings was given. In flight the females gave single chucks much like the notes of red-wings. About the nesting sites they had a variety of harsh, screeching notes.

Another elaborate display often accompanied the song of the male. In 1 form of this display the tail was spread, both wings were raised high over the back, and the body feathers were raised. The birds seemed to have difficulty in maintaining a balance during this performance. No observations made indicated that the females paid any attention to the display or to the notes which accompanied it. At 1 colony these displays were noted as far along in the cycle as the time when nearly all the nests held small young.

Another form of display, noted immediately after coition, was exhibited by a male which followed and perched close to (within a foot of) a female. Its feathers were raised, and the whole body was tilted so that the head pointed downward at a 30-degree angle with the horizontal and in line with the tail. The bird left after about 2 minutes.

When 1 male came near another, one of them being outside its normal territory, each was liable to fluff out its feathers. This type of display may have been used for intimidating the other male. No definite result of its use was detected.

On June 10, 1933, an elaborate example of this kind of display was watched as it was enacted by 2 males which owned adjoining territories on the east side of the pond. They were seen on the ground halfway between their respective singing posts which were in separate cattail patches about 20 feet apart. For 3 or 4 minutes they kept close to each other, walking back and forth along the boundary with fluffed feathers and arched necks. In turn, they made short flights, getting scarcely more than a foot above the ground and moving, altogether, only 3 or 4 feet. Once one went as far as 10 feet. In these flights the wings were flapped violently, but the bird moved slowly, and the body was held with the bill pointing upward 80° above the horizontal. Finally, each bird returned to its own singing post, having had no actual combat. The whole performance had included only a few vocal notes.

Not all encounters between males were as harmless as the one just related. At about 9:30 a.m. on May 16, 1932, the male from territory III flew across the pond to where male number II was on the ground on the western shore, and there was severe fighting for approximately 30 seconds. During this time there were few sounds. Number III held down number II and picked at it. Then the two separated and number II flew after number III as it went to the center of the pond, and both went down among the plants (*Hippuris*). There number I joined the fighting pair. Soon all 3 birds returned to their territories, II first, then I, and, finally, III. After returning to their singing posts, none of the birds showed evidence of special excitement. There had been no obvious accomplishment; possibly this rehearsal had no significance except as a device for maintaining the habits which are necessary in territorial defense.

Pursuit of a female by a male has been observed and commented upon by other workers as an important part of the courtship activities of some kinds of birds. This activity has been worked out for the red-winged blackbird by Allen (Proc. Linn. Soc. New York, 1914, pp. 44-128). When not on singing perches or at feeding places, male yellow-headed blackbirds spent most of the time in pursuit of females. Usually after a long and circuitous flight the female came back to a perch near the starting place, and the male settled quietly near there. Sometimes the male displayed actively just after a chase.

One morning (May 18, 1932), males II and III were at their singing posts, and females were seen in territory II, but none at III except one which was pursued across the pond and back by male II. Male III joined in the chase and apparently helped drive the female back to territory II. Later a female flew across to territory III and went down among the cattails. Male III flew to the same place and stayed there, out of sight and quiet, for about 1 minute, until alarm notes of red-wings showed that a marsh hawk was near by. It then took a perch higher on the cattails.

Once 3 females arrived together at the pond from the east, and the group was pursued in turn by each of the 4 males at the pond, whereupon the females flew off toward the west. On June 10, 1933, fewer pursuit flights were noted than had been seen previously. When such a flight occurred, the other males usually watched or flew out too.

Males were noticed flying to females especially when the latter uttered a certain type of screeching note. Sometimes these notes were given on the pursuit flight. The notes along with the posturing of the female seemed to be the signal that the female was near the mating stage.

Mating of yellow-headed blackbirds was noticed in late afternoon on May 26, 1932. In territory III a female flew to the top of a currant bush where it postured, and then male III flew there from the cattail patch and they copulated. The union lasted about 2 seconds during which the male flapped its wings rapidly. After perching a few inches away for a short time, the whole procedure was repeated until it had taken place 9 times in quick succession. Then the male flew back to the cattails where it perched on a dead stem and shook its plumage. The female may have been the same one noted earlier in territory II. Posturing, with bill and tail pointed upward, had been noticed there, but male II had made no response. The circumstances seemed to indicate that male III was the only one ready for mating, and the female hunted it out.

In 1933, coition was noted in the same part of the pond on the morning of June 10. This time it took place on a cattail stem close to the water and was repeated 4 or 5 times. Then, when the female moved to a new perch, the male followed and displayed. It left after about 2 minutes, and then the female left. A few minutes later a female was seen posturing on a dead stem of a bush on the shore. The tail was held at a sharp upward angle, the wings quivered, and low notes were uttered. A male approached, but when

it came near the female, the latter flew away. The male then bathed and dried its plumage.

After nest building was started the females were active in defending the immediate vicinity of each site from intrusion by other females. On several occasions a female was hurriedly driven away by another whose nest had been approached too closely. This jealousy did not extend to other parts of the territory. Females from separate territories were seen peaceably gathering nesting material from common ground. All nest building seemed to be by the females.

Nests were never started except over water. If the water dried up in early stages of construction, the nests were invariably deserted. However, the birds continued to occupy the nests, where the water remained until after eggs were laid.

A disparity in numbers of the sexes in nesting colonies has been mentioned. Apparently many more females are engaged in nesting, each season, than males. Our observations gave basis for the supposition that this was not a result of an uneven sex ratio, but, rather, a result of differing time of maturity. My guess was that the females began nesting when they were 1 year old, but that the males did not nest in their first summer nor until they were nearly 2 years old.

No females were observed that were not on their nesting ground in the proper season. However, many males were seen, day after day, which perched on certain bushes out on dry ground $\frac{1}{2}$ mile, or farther, from water. These birds sang, but their songs were not so long nor so loud as those of nesting males. Also all these males were less brightly colored than were nesting ones. Indications were that they were yearlings which would not nest until the following season.

On the morning of May 19, 1932, the small pond was examined for nests of yellow-headed blackbirds. The 3 territories held nests of this species as follows: I, a nest with only the basal part completed; II, 3 old nests of a previous season and 2 freshly built and apparently completed nests 9 feet apart, 1 with some green cattail leaves in its basal part; III, 2 nests barely begun. The nests, in each patch, were over the deepest water. By May 30 the nests, except 2 in territory III, had been deserted. These 2 had been completed. One, close to shore and 3 feet above the mud, held 3 eggs. Already there was a considerable amount of excrement on and about it. The other nest, 20 feet away and 15 inches above water $1\frac{1}{2}$ inches deep, contained 2 eggs. The male was giving low chuck 60 feet away.

On June 8, both these nests held 4 eggs and in the same territory was found a third, new, but empty, nest. One male and 3 females were present. Evidently 1 female had settled there considerably later than the other 2, but it had been able to establish itself. None of the 4 birds exhibited concern over being disturbed.

Results of search of this pond for nests in the 1933 season are shown in the following tabulation.

Territory	Nest no.	Contents	
		June 10	June 15
III a ₁	1	2 eggs	empty
III a ₁	2	empty	2 eggs
III a ₁	3	empty	3 eggs
III a ₂	4	1 egg	empty
III a ₂	5	2 eggs	empty
III b	6	empty	4 eggs
III b	7	empty	empty
II	8	1 egg	4 eggs
II	9	----	empty

Evidently some animal had raided the colony between the 2 dates and had emptied nearly all the nests. The birds whose nests had been empty and hence not disturbed had gone ahead with their laying; the others had deserted.

In the early summer of 1932 water from streams in the Toyabe Mountains flooded parts of Smoky Valley. Within the flooded area was a patch of willows 5 to 7 feet high and approximately 100 by 50 yards in diameter. At this place the water was 1 to 1½ feet in depth. Yellow-headed blackbirds took over the willow patch and nested there. On June 8 the colony was examined and nests found as follows:

No.	Contents	State	Height above ground
1	4 yg.	1 hatching	1 ft.
2	2 yg. 2 eggs	hatching	3 ft.
3	4 eggs	-----	4 ft.
4	2 yg. 1 egg	hatching	15 in.
5	4 eggs	-----	2 ft.
6	4 eggs	-----	30 in.
7	4 eggs	-----	30 in.
8	empty	¾ finished	4 ft.
9	3 yg. 1 egg	hatching	3 ft.
10	4 eggs	-----	30 in.
11	4 eggs	-----	1 ft.
12	4 eggs	-----	3 ft.
13	4 yg.	just hatched	42 in.
14	3 eggs 1 yg.	hatching	1 ft.
15	3 yg. 1 egg	hatching	2 ft.
16	3 yg.	2 or 3 days old	3 ft.
17	empty	freshly built	2 ft.
18	4 eggs	-----	30 in.
19	3 yg. 1 egg	2 or 3 days old	2 ft.
20	4 eggs	-----	30 in.
21	empty	¼ complete	3 ft.
22	4 eggs	-----	4 ft.
23	2 yg. 1 egg	hatching	4 ft.
24	4 eggs	-----	42 in.
25	4 eggs	-----	2 ft.
26	3 yg. 1 egg	hatching	20 in.
27	4 yg.	small	2 ft.
28	4 yg.	small	1 ft.
29	4 eggs	-----	10 in.
30	2 yg. 2 eggs	hatching	15 in.

It was estimated that of the larger clumps of willows, 1 in 25 contained a nest. In no case were 2 nests in the same bush, and no 2 were nearer than 6 feet apart. Twenty-four out of 30 nests had 4 potential young; 3 had 3.

Agelaius phoeniceus nevadensis Grinnell

Colonies of red-winged blackbirds in Smoky Valley were much more numerous than colonies of yellow-headed blackbirds. Also they seemed more successful in their nesting although numbers of individuals in each colony seemed to be no larger. This species had much less restrictive requirements for nesting sites than its yellow-headed relative. Not only did it have a wider range of choice in the original selection, but it showed greater aptitude in accommodating itself to physical changes such as drying out of the habitat.

Just as in many other species which nest in marshes, the presence of water appeared to be the first requirement in determining the local presence of nesting colonies of red-winged blackbirds in this region. Usually some kind of plant such as cattail was present to provide perching places and nest support, but in the absence of this or a substitute plant the blackbirds did not hesitate to place their nests down among low grasses and sedges on hummocks in marshy ground. In this region, however, these birds did stick to the near vicinity of water. Just how water served to attract the birds is not known. It seems probable though that it affected them through the provision of a more abundant, suitable food supply than was to be obtained in drier parts of the region. In addition it seems likely that individuals are attracted to moist ground through a set of factors, as yet not well defined, which function through the visual sense.

When our first work was done in the Toyabe region on April 20, 1930, several red-winged blackbirds, both males and females, were scattered singly or in small groups in clumps of willow, rose and other bushes around springs and seepy places in Smoky Valley, 5 mi. SE Millett. Time of arrival in spring was evidently much earlier than this. Similarly, in the fall this species was present beyond the time of our latest observations, made on September 11, 1931.

All colonies of this species observed were in Smoky and Reese River valleys except two that were on the meadows on Birch and Kingston creeks. Along Kingston Creek, red-winged blackbirds were seen in mid-June in at least 3 places.

Feeding in this species most often took place on the ground in marshy areas or at the margins of ponds. However, other important sources of food were not overlooked. At 1 colony, on May 15, 1932, both males and females spent most of the time between 10 a.m. and noon flying into the air after insects. They flew less often when the wind was blowing than when the air was still. The insects sought were of various sizes—some of them were easily visible at 75 yards. Even when feeding, the males usually perched higher than the females, which kept close to the water.

On the morning of May 18, 1932, a male red-wing was seen to catch a large dragon fly and to swallow it head first, wings and all (Orr). Later in the morning the same bird flew out 30 feet from its perch and captured

another dragon fly which it swallowed in the same manner as it had the first one. Another time a female was seen with a dragon fly it had captured.

Almost every colony of red-winged blackbirds had a nest of marsh hawks close to its center. This close proximity of these species made it possible for us to study many phases of the constant warfare waged against hawks by the blackbirds. For example, about noon on May 16, 1932, when a marsh hawk flew over a blackbird colony, in hunting flight, several red-wings gave their shrill, high-pitched whistle of alarm. One or 2 flew at the hawk, but they took care to keep behind it and to dive quickly to cover when the hawk turned. On other occasions blackbirds flew after marsh hawks in attempts to drive them away, but apparently with little effect. When the chase ceased, the red-wings always dived to cover with great speed. Evidently this was a dangerous procedure because it gave the hawk an opportunity to catch the retreating blackbird. Of all the birds in the vicinity this one seemed most concerned at the presence of marsh hawks. A large part of the blackbirds' time was spent in giving alarm notes, hiding from, and flying at the hawks.

A male red-wing that was watched on May 24, 1932, spent most of its time perched in the top of a buffalo-berry bush close to the cattails, on the dead cattail stems, or flying after a female marsh hawk which circled over the marsh. When chasing the hawk, the blackbird kept a position above and behind the larger bird, occasionally speeding up to strike it on the back with the bill. On this and the following days, without exception, as soon as the hawk moved over the marsh, either from a perch or from outside the area, the male red-wing flew to it and followed it until it perched or left the blackbird's territory. On no occasion did the blackbird molest the hawk while it was perched. A few times one or more females flew after the hawk when it was directly over their nests, but only once did I see a female strike it.

On May 30, 1932, it was recorded that within the few preceding days there had been an apparent slight change in the procedure of attacks upon hawks by the blackbirds. They followed the hawks more closely, hit them more often, and retreated less quickly than they had earlier in the season. This probably could be accounted for by the advance in the nesting cycle of the red-wings. Apparently their ardor for defense of the nesting site increased with the progress of their nesting.

The usefulness of this continued badgering of marsh hawks whenever they came near a red-wing colony seemed to be in keeping the attention of the larger bird so occupied that it would have no time or inclination to harm the smaller birds or their nests. Only moving hawks were recognized as harmful. The attacks ceased the moment the hawk perched. That the hawks were inconvenienced by the attacks was indicated by their usually showing an inclination to escape. Often when a hawk was obviously on the way to its nest, it changed its course and left when the blackbirds became vigorous in their pursuit.

Aside from the numerous encounters with marsh hawks, there were many occasions when the routine of red-winged blackbirds was interrupted by the presence of larger birds. On May 16, 1930, a male that was perched in the tip of a willow clump when a prairie falcon approached, uttered loud, shrill

whistles continuously for several seconds, and at the same time jerked its tail vigorously. All the other blackbirds in the vicinity became quiet and flew to cover. Two blackbirds in a willow when a sharp-shinned hawk flew by on May 13, 1930, uttered high-pitched squeals as the hawk passed them. On May 17, 1932, a turkey vulture and a Swainson hawk came near red-wings at different times, and, each time, the male red-wing produced the same warning call as it did when a marsh hawk was near it.

On May 29, 1932, red-winged blackbirds at 1 nesting colony uttered alarm notes while a black tern was flying over the pond. No hawk was in sight. When a nighthawk flew low over a red-wing colony on June 12, 1933, a male red-wing pursued it. Male red-wings pursued a female mallard on a pond on June 16, 1933. On June 22, 1933, a blackbird flew at and pestered a black-crowned night heron that lit in the bare roadway near the crossing of the Reese River on the Lincoln Highway.

When I first arrived at 1 nesting area on May 29, 1932, a magpie was in the vicinity. Several blackbirds were flying about it, calling anxiously in an attempt to drive it away. They seemed instinctively to recognize this bird as a potential source of danger.

Whenever a red-winged blackbird entered the occupied territory of a yellow-headed blackbird, it always retreated before a male of that species. When yellow-headed blackbirds finally withdrew from a nesting site, the red-wings quickly moved in and started nesting. At one such site on May 18, 1932, when no yellow-head was in sight, there were present in the cattails 2 male red-wings and a female. One of the males pursued the female, flying to her every time she perched. Each time, the female moved to another perch. On May 29, a male and female red-wing were seen feeding on the mud and in the shallow water at the margin of this pond. On many occasions red-wings temporarily occupied nesting territories of yellow-headed blackbirds while the owners were away on foraging trips, but the invaders quickly retreated upon the return of the larger birds.

During the 1933 nesting season at least 2 pairs of red-winged blackbirds settled and began nesting in a patch of cattails in the pond where yellow-headed blackbirds nested each year. On the morning of May 24 a female was carrying nesting material, and on May 27 another was building in the same pond. This nest was completed but empty on June 3. By June 7 the yellow-heads had arrived and had established themselves at this pond. All the red-wings had been driven away except the pair with the completed nest, but by June 10 this one too had been abandoned, and the yellow-heads had gained complete possession of the pond. One of the pairs apparently retreated to a new site 50 feet away in a near-by marsh. The completed nest on June 10, held 5 eggs.

A reversed condition sometimes held when a yellow-headed blackbird came onto the occupied and established nesting area of a red-winged blackbird. On May 25, 1932, when a male yellow-head lit within the territory of a male red-wing, the latter flew to the same bush and perched within 4 feet of the intruder, then flew to attack a marsh hawk. Later in the after-

noon another male red-wing flew after the male yellow-head and chased it away from a perch close to the ground in the vicinity. The intruder retreated 25 yards and perched in the top of a buffalo-berry bush, whereupon the red-wing returned to its perch in the marsh. On the same day a male flew after and chased away a female yellow-headed blackbird which however returned and was pursued again.

A male red-wing was seen on May 28, 1933, to chase away a male Brewer blackbird which came near the red-wing's bushes. On June 14, a female red-wing flew off its nest on the day of hatching to chase away a Brewer blackbird which came too near.

Another sort of relation to other species was noted occasionally when red-wings were protesting at our disturbance of their nesting by too close approach. Once a meadowlark came to a marsh and showed concern along with the resident birds of that spot. Another time a pair of Brewer blackbirds came from their own nest site some distance away to join red-wings that were protesting at the presence of a person.

In the latter part of April most of the red-winged blackbirds, especially the females, were in small groups of from 3 to 8 individuals. The males tended to be stationed singly. Apparently, at that time of year, they gathered in small flocks toward evening to roost. In a female killed on April 21, the ova were still small, as they were in 2 examined on May 13. A female was seen carrying nesting material on the latter date. On June 2 many were scattered over 1 patch of marshy ground. When a shotgun was fired close to them, they gathered into small groups of 3 to 8 individuals and flew off silently, but they soon returned.

Males of red-winged blackbirds paid less attention to one another and had fewer conflicts than did males of yellow-headed blackbirds. Once a male red-wing stopped pursuing a marsh hawk to drive away another red-wing that entered its territory. The intruder left peaceably. This latter individual was seen the same day chasing still a third male from the vicinity of its own chosen perch.

Just as in the yellow-headed blackbird a great disproportion was noted in the numbers of males and females at each nesting colony. This was not always apparent upon casual watching, but close study revealed it to be the condition practically everywhere. At 1 or 2 places where there was only a single nest there was 1 male and 1 female, but usually there were several females and several nests for each male in the colony. Once on May 14, 1932, 1 such group composed of 1 male and 6 females flew up from a marsh in Smoky Valley and lit on a buffalo-berry bush. When these birds were approached slowly, the females left fully 15 seconds before the male moved (Orr). This greater attachment of the male for the nesting site was noted many times in the early part of the nesting season.

The males were fairly persistent in maintaining the stands which they established at the beginning of the nesting season. The success of a male in obtaining females in its territory seemed to depend almost entirely upon the suitability of the habitat for nest locations. A male with a thickly grown stand of strong, upright cattail stems would have as many as 6 females all

actively nesting. Another in a less suitable part of the same marsh might have only 1 female. At least 1 male kept a territory throughout a season where the sites for nesting were few, there being no tall vegetation, and not a single female settled there.

Because a more nearly complete history of 1 season of nesting of red-winged blackbirds was obtained at 1 pond than at the other nesting areas, a summary of the notes made there is given here. The value of a chronological account seems greater if details are given even where they repeat some items suggested elsewhere. The pond was one of the largest ones studied in Smoky Valley and it had a well established growth of cattails and bulrushes as well as other aquatic plants and an adjacent, large clump of willows.

On May 19, 1933, when observations were made here first, there were about 15 individuals foraging about the pond at 6:30 a.m. More of these were females than males. A male flew after and pursued a female at great speed. The latter left and the male returned. Another time, a male drove a female from a perch but did not pursue it. The females were generally closer to the water. At noon several individuals, both males and females, were actively feeding on insects caught on the wing over the pool.

Early in the morning on May 23, at least 4 males and a greater, but undetermined, number of females were noted here. Once a male chased a female away from the marsh, but both returned. No male was seen actually to chase another male although a new arrival of that sex was usually joined by another soon after alighting. Often 2 males came within a foot of each other. At such times they would hold their bills pointing upward, but not vertically. Between 7 and 7:30 a.m. at least 1 female was carrying material to a nest in the marsh.

A nest examined in this colony on May 24, was about half completed, and was being constructed of wet material. Its rim was only 8 inches above the water in dead stems of cattail. The birds protested at my approach to the site. There were few good nesting sites on the pond, for the stems of the plants had been broken and bent too close to the water.

Beginning at 6:30 a.m. this colony was watched on May 28. Up to 8 o'clock these birds exhibited more excitement than I had seen previously in this species. About 5 males were present and more than that number of females. About half of each individual's time was occupied in feeding at the water or catching insects in the air, at heights up to 50 feet.

There were too many birds to determine whether there was any marked division of the area, but apparently there was little if any. No nest building was seen, but several locations in the cattails were visited regularly, possibly by the same birds each time. Both sexes uttered chattering notes, especially when in flight. The males sang from the tops of posts and from perches in cattails. Several times one perched and quivered its partly spread wings for some time or stood with nearly all the feathers fluffed out. No combats between males were noted, but once or twice when one flew toward where another was perched, the latter moved to another post.

Several times a male flew after and chased away a female. Once 2 females

arrived together. A male immediately drove them away for about 100 yards, but they soon returned. Then a second male pursued them, and after that a third one again took up the chase. Sometimes when in these pursuit flights, a note was heard which resembled and possibly was the same as, the one given when a red-wing came near a hawk which it was driving. The females usually returned after these drives.

Almost continually 1, or another, female was heard uttering rapid series of short, staccato, whistling notes. They perched on a post, on a bush, or on the ground. Accompanying these notes the bird held the bill open and moving, the wings partly spread and rapidly waved, and the tail raised to a 45° angle. Sometimes the notes and fluttering were continued in flight to another perch. Then the bird would resume its foraging. I could not determine that other individuals paid particular attention to these postures, but the performances may have contributed to the general heightening of the excitement that was apparent in the group. Actual coition was not seen until 8 o'clock and then not clearly. A male flew to the ground where it was concealed by grass, and the wings were waved widely for several seconds. Then it flew to a post close by. Afterwards a female moved away from this location.

Once when a female marsh hawk flew over the marsh, the blackbirds uttered alarm notes and several others, mostly males, flew after it. The hawk gave notes of protest and left. The blackbirds were much more quiet between 8 and 9 o'clock.

Early in the morning of June 6, the blackbirds, especially males, in this colony were much more active than they had been previously. One male spent most of its time for an hour pursuing females. It chased as many as three, sometimes two, at the same time. Usually it went after them whenever they perched high or flew across the pond, but it also went to the ground and in and around the bushes after them. The females merely flew in circles or went into a clump of brush. I saw none actually leave the area.

When perched, the males spent most of the time singing and in display, with the feathers fluffed out and the wings and tail shaking and spread, often with the head held low, bill pointing downward and the wings half-opened. Often when 1 male perched near another, the cowbird-like pose with bill pointed upward was taken by one. This was not seen when a male was near a female. The males spent some time down close to the water, but mostly they perched on posts, tops of bushes, or cattails. The females spent some time posturing, with wings quivering, tail raised, and uttering the whistle-like trill. At least one of them was carrying fine material for a nest lining. When a marsh hawk came near the colony it was chased by both males and females.

A little after 7 o'clock 3 young (yearling?) male yellow-headed blackbirds flew to the pond. They were pursued by male red-wings and for just as long as they were in flight. When they lit in a buffalo-berry bush, the red-wings lit near by but did not fly at them.

On the morning of June 11, an adult male yellow-headed blackbird was stationed in the center of this red-wing colony. It pursued female red-wings several times and each time was itself pursued by a male red-wing. The latter paid little attention to the yellow-head when it was perched. When a female yellow-head lit in the marsh, a female red-wing hurried to chase it away, and the 2 were followed by a male red-wing. By the next day less attention was paid to this intruding pair. A half-completed nest made by this pair of yellow-heads was found at noon on June 16. This showed that the birds had held their location in the center of an occupied red-wing colony, and that they were really nesting. By this time the red-wings still flew at the male yellow-head whenever it moved, but it was not molested as long as it was perched.

On June 11, several females were carrying nesting material at this colony. One was noted posturing once. This one was chased away from the vicinity by another female and twice by a male. Not many females were seen here on June 12. On June 16, one was carrying nesting material to a place among sedges outside the cattails. Apparently this was the last nest to be built in the colony.

Time of nesting activity in Smoky Valley is shown best, perhaps, by chronological arrangement of items which signify various stages in breeding cycle.

- May 17, 1932 2 females carrying nesting material in a.m.
- May 18, 1932 Nest with 4 eggs, 1 with 3 eggs, and 1 empty.
- May 19, 1932 2 nests with 4 eggs each, 2 freshly lined and empty, and 1 not yet lined.
- May 20, 1933 Female carrying nesting material.
- May 22, 1932 Female carrying nesting material.
- May 23, 1933 Female carrying nesting material.
- May 24, 1932 Nest with 3 eggs, 1 with 1 egg, 1 empty.
- May 24, 1933 Female carrying nesting material.
- May 25, 1933 Nest half finished.
- May 26, 1933 Nest with 5 eggs, 1 with 3 eggs, 2 empty.
- May 27, 1933 Female carrying nesting material.
- May 28, 1932 Nest with 5 eggs, 1 with 4 eggs.
- May 28, 1933 2 nests nearly completed.
- May 29, 1932 Nest with 5 eggs, 2 with 4 eggs, 1 with 2 eggs and 2 young.
- May 30, 1932 Nest with 5 eggs, 1 with 4 eggs, 1 with 3 eggs, 1 with 1 egg, 1 empty.
- May 30, 1933 Nest with 4 eggs, 1 with 2 eggs, 2 empty.
- May 31, 1932 3 nests with 5 eggs, 6 with 4 eggs, 1 with 4 young, 1 with 2 eggs and 2 young.
- June 3, 1930 Nest with 1 egg and 3 or 4 small young.
- June 3, 1933 Nest complete but empty.
- June 4, 1933 Nest with 5 eggs and 1 with 4 eggs.
- June 6, 1933 Female carrying nesting material.
- June 7, 1932 Nest with 4 eggs, 1 with 4 eggs and 1 young, 1 with 5 young, 3 with 4 young, 2 with 3 young and 1 egg, 1 with 2 young and 2 eggs.
- June 7, 1933 Nest with 5 eggs, 1 with 4 eggs.
- June 8, 1932 Nest with 1 egg, 1 with 4 young.
- June 10, 1933 Nest with 5 eggs.
- June 14, 1933 Nest with 4 eggs, hatching.
- June 15, 1933 Nest with 5 eggs.
- June 16, 1933 Nest with 5 eggs, 4 with 4 eggs, 1 with 1 egg, 2 with 5 young, 2 with 4 young, 1 incomplete.

Examination of the materials upon which the above tabulation is based reveals several points of general interest. In the first place nearly all the nesting—nest building, laying, and incubating—of this species in Smoky Valley takes place in the month between May 15 and June 15. The peak of nesting activity comes about June 1. Probably the largest number of nests with eggs could be found at that time.

Approximate length of the incubation period was noted at 1 nest which was completed but empty on May 28. On June 11 it contained 2 recently hatched young and 3 eggs. This allows 14 days for laying 5 eggs and for incubation.

Number of eggs per set in the red-winged blackbird varies around 4 and 5 with more sets containing 4 than any other number. The average number then is lower than in the Brewer blackbird (5 or 6) and higher than in the yellow-headed blackbird (3 or 4) in the same area. This difference in potential rate of reproduction may be explainable on the basis of some specific differences in survival rate. During the winter season and in the migrations these 3 kinds of birds are often in the same places and even in the same flocks where presumably they live under nearly similar conditions. The most obvious contrast in the lives of the species is in the degree of restriction in the nesting site. It is pointed out elsewhere that the yellow-heads are closely restricted in choice of nest site to marshes where there is standing water, that the Brewer blackbirds show greatest range of choice in this regard, and that red-wings are intermediate between these two. The average number of eggs per set rather closely parallels the degree of restriction in nesting site. The species most closely restricted lays fewest eggs.

A feature of the nests of red-winged blackbirds of special interest was noticed in Smoky Valley. This is that the lining in nearly every instance was pale yellow or whitish in color. This contrasted especially with the almost invariably dark color of the lining of the nest of the Brewer blackbird. In these 2 species as in others which had light or dark colored nest linings, the whitish lined nests were in open situations often exposed to the sunlight, the dark lined nests were in shaded places usually protected from direct sunlight. This contrast extended also to the color of the down on nestlings. Nestling red-wings had conspicuously whitish down, nestling Brewer blackbirds were decidedly blackish. These seem fairly obvious examples of adaptations to exposure to sunshine—the whitish nests and young to reflect sunrays, the dark ones to absorb them. Apparently it is desirable for both the eggs and young birds to be thus protected.

Conspicuously situated nests such as those of red-winged blackbirds would seem to be especially liable to destruction. That they are often destroyed is indicated by the readiness with which the birds desert nests in process of construction. We had opportunity to observe 3 kinds of harm to nests or their contents. Several nests under observation that had contained eggs were later recorded as empty but otherwise undisturbed. In absence of direct evidence it seems probable that these nests were emptied by gopher snakes which were seen rather frequently in the habitat. One nest was destroyed by being trampled by cattle feeding in the cattails which held it. One small group of

nests was threatened by being in green, growing cattails which provided unstable support. One whole egg was found, on May 19, 1932, out on the mud at the margin of a pond.

Icterus bullockii (Swainson)

Bullock orioles nested in the trees close to ranches. Apparently climatic conditions were not suited to this bird in the mountains. The small summering population, however, gave little indication as to the true nature of the limiting factors for this species.

Earliest Bullock orioles were noticed May 12, 1930, in willows and stream-side thickets along South Twin River, 6500 feet. In 1932 the first one was detected on May 24, among bushes 5 mi. SE Millett, and in 1933, on May 20, in the same vicinity. All through the latter part of May and early June, individuals which seemed to be transients were noticed in this vicinity; some of them may have been mated birds that had settled for nesting. During the period of field collecting from August 29 to September 11, 1931, no oriole was seen in the Toyabe region. Thus this species is among those which arrive late and leave early, another indicator of preference for a warm climate.

On June 9, 1932, orioles (possibly only 1) were singing in a large cottonwood at the corner of the garden at Millett. Thirty feet up in the outer part of a limb of the tree was a nest with the appearance of being freshly constructed. In the same neighborhood on June 14, 1933, a nest was found 20 feet up in the center of the crown of a cottonwood 25 feet high. It was made of plant fibers and black horsehair in the outer walls and was lined with wool and white horsehair. In it were 5 eggs. No bird was on the nest but one was near. Twenty feet to the west in a similar but slightly larger tree there was a nest of a previous year and similar to the occupied one. The old one had the floor covered with droppings. On June 22 the young had hatched and were 1 or 2 days old. They had white down. When the tree was climbed the female protested vigorously, diving at the intruder repeatedly and, once, hitting him on the head.

At the ranch near the mouth of Kingston Cañon, 6500 feet, at least 3 pairs of orioles were detected on June 17, 1930. One pair had a nest at the tip of a limb 30 feet from the ground in a large locust tree in the middle of a meadow. The female was obtained and examination of it revealed that a set of eggs had been laid within a short time. A second pair was in a group of tall willows close to the stream and the third was only 50 yards away in the cottonwoods over the house. This pair was watched as the birds flew together to sage brush not far away where they fed among the bushes for 5 minutes and then returned to the cottonwoods.

Orioles were heard once on June 26, 1930, in Austin, possibly indicating the presence there of nesting birds.

Euphagus cyanocephalus (Wagler)

Brewer blackbirds in summer inhabited a greater variety of situations than did other members of their family in the Toyabe region. They were found in small colonies in Smoky Valley as were most of the Icteridae, but also they lived in the mountains as high at least as 7500 feet. Colonies varied in size

from 3 or 4 to about 20 pairs. One feature that appeared to be common to the nesting sites of the colonies was the near-by presence of wet ground. Evidently the moist ground attracted the birds by providing more favorable forage than the dry ground in this area. Practically all the foraging was done on the ground.

Locations of nests seemed not to be dependent directly on presence of wet ground. They ranged widely in type of situation, sometimes being directly above or immediately surrounded by water. Other times they were in bushes many yards from the nearest moisture. Also there was no uniformity in distance of the nest from the ground, except that within each colony the pairs tended to select similar nest sites.

In Smoky Valley, 5 mi. SE Millett, there was greater opportunity to study the nesting of this species and to compare it with other kinds of blackbirds than at other localities. Observations on this bird began there in 1930 on April 21. On that date several individuals were seen on the ground, singly, at margins of pools of water. During the next 2 days it was noted that in specimens examined the gonads were less far developed than they were in red-wings. By May 13 several pairs were noted that seemed to be settled on nesting territories. The females were on the ground, and the males were perched in near-by tall bushes. A female examined on this date contained an enlarged ovum.

Several groups and single individuals were seen about shallow pools on May 15. Like other blackbirds in the vicinity they were hard to approach and usually would fly when approached within 200 yards. One female on this date showed ova 2 or 3 mm. in diameter. A group of about 8 individuals at the same site on May 15, 1932, apparently was not yet nesting. On May 19, 1932, half an hour was spent watching birds at this place. At one spring there were 2 males and 1 female. One male remained perched in the top of a tall bush. The other 2 birds kept down in the brush fence around the spring. The female was moving about but gave no indication of nesting activity. Finally the male on the high perch flew down to the ground and began to feed. When I approached the spring, all the birds flew off. Two pairs were noted about this spring on May 19, 1933. One male turned over pieces of cow manure with its head and looked beneath them for food.

On May 29, 1933, a pair was noted early in the morning on posts of a corral. When a second male came and perched on a post, the first male flew up and lit near it and posed with its bill in a nearly vertical position. Finally all 3 birds left. Once when a male of this species lit near a colony of red-winged blackbirds, a male red-wing drove the intruder away.

A fairly large colony of blackbirds nested in 1933, among scattered buffalo-berry bushes and willows near some dried up ponds east of Rogers. On May 30 the birds were scattered about in pairs, but I could find no nests. This place was visited again on June 4. About 10 pairs of blackbirds mobbed a great horned owl near the center of the nesting area and followed it when it left. A male pursued a meadowlark which came on the area. A more thorough search on that day revealed nests as follows.

1. Four feet above the ground in a clump of buffalo berry and wild currant 7 feet high among scattered clumps of the same sort. Nest resting mainly in a crotch of buffalo berry which was leafless. Grayish in appearance and not large, mainly constructed of small stems. Lined with grass stems and a few black horsehairs. Contents 5 eggs.

2. Site 20 yards southeast from last, 3 feet above ground in wild currant bush in center of thicket of dead buffalo-berry bushes 7 feet high and 20 feet across. Nest nearly complete but empty.

3. Site 30 yards southwest of last, 4 feet above the ground in wild currant and dead buffalo berry. Nest made mostly of sedge and grass stems. Depth outside 19 cm. Rim inside 8 by 10 cm., outside 15 cm. A slight depression in rim on side where used as entrance. Contents 6 eggs. Brooding female left after I stopped beside nest, but kept close by and protested loudly and persistently.

4. Site 50 yards west of last, 18 inches above the ground a little north of the center of a rose bush 4 feet high and 6 feet across. Nest constructed mostly of sedge and grass stems, supported on dead stems of the bush and grass. Diameter of rim outside 16 cm.; inside 9 by 10 cm. Contents 5 eggs. Brooding adult flew off with a flutter in the bush after I stopped near it, and the bird gave alarm notes near by.

5. Site 150 yards east of last, 4 feet up in clump of currant and buffalo berry, surrounded by taller clumps of buffalo berry than the other nests, but close to open ground. Nest made of fine shreds of plant material, sedge and grass stems. Some black horsehair in lining. Contents 3 eggs. Brooding female left nest, when I was 8 feet away, and perched in margin of bush until I came nearer. The manner of nest leaving noted at this colony seemed to be peculiar to it. No such habit was noted elsewhere. There were 5 eggs on June 6.

6. Nest found on June 11, on ground at northwest base of a buffalo-berry bush 2 feet high. Partly shaded. Rim only a little above ground level. Contents 2 eggs and 3 just-hatched young. Female flushed when I was 4 feet away. Site 20 feet from a large buffalo-berry thicket.

On June 11, 1933, 7 nests were found at another colony $\frac{1}{4}$ mile northeast of the one described last. Each of these nests was on the northeast side of a rose bush which stood on the margin of a dried-up basin of a pond. Most of them were about 2 feet above the ground. One nest contained 6 eggs, one had 4 small young and 1 egg, one had 4 eggs and a small young bird, three had 5 eggs each, and one was empty. This one was slightly tipped, and there were broken eggshells on the ground beneath it.

Evidently there was continuous communication between the 2 last-described colonies, even though they were more than 300 yards apart. Birds were seen flying back and forth between areas even when there seemed to be no disturbance to attract them to either place. Also they perched in the intervening bushes.

At another open marshy area in Smoky Valley, 4 mi. SE Millett on

May 20, 1932, several pairs of blackbirds were seen feeding on the ground or perching in rose, willow, and buffalo-berry bushes. At 1 spring where only a male was seen, a female was driven off a nest by a close approach, within 20 feet. The nest was in the inner part of a brush fence around the spring and only a foot above the water. It was made of fine, round stems and was gray in color, with a lining of grass stems and horsehair. It was only partly shaded by brush and dead and green sedges. This nest was empty on May 30.

About 50 feet northeast of the last location was a small spring only 5 feet across in which there was a small pile of cut buffalo berry. In this there was a nest whose rim was a foot above the water and base only 6 inches up. It was lined with black horsehair and held 5 eggs. I saw the female leave the nest. Several pairs of adults remained in the neighborhood uttering alarm notes from the tops of tall bushes. These consisted of *chucks* and high-pitched whistles. Also there were some songs. Another nest 2 feet up in a small rose-buffalo-berry thicket contained 1 egg.

Two other nests in this locality were in the tops of hummocks of sedge, about a foot above the surrounding wet ground; each contained 6 eggs. One of these contained 6 small young on June 7. Another nest found on June 7 in a similar site contained 5 eggs.

During the half hour I spent at this colony on June 7 no individual was seen to go to a nest although several, both males and females, went close to nests. Most of the blackbirds stayed on the tops of buffalo-berry bushes or shifted from 1 bush to another. They seemed to maintain their alarm at my presence at about the same pitch for the whole time. This was mainly expressed by harsh notes, but soft ones were heard too. When the pairs moved, the male usually kept close to and followed the female. Two males joined to drive a female marsh hawk from over the marsh. When they turned back, 2 others continued the chase. The hawk speeded up and flew directly away to the south. One male blackbird was seen to drive another from a perch in a bush. Two females with food in their bills were perched near each other on a buffalo-berry bush.

At this same marsh on June 2, 1933, 5 nests were found completed or in various stages of completion (Compton). All were in hummocks of sedge in the marshy ground, with water standing around most of the hummocks. The nests were made of grass or sedge stems. One was completed and contained 5 eggs. The others were in various stages from ones just started to ones completed except for a lining. The nests had been started by first separating the sedges and tearing out and scratching away all the dead grass until the soil was exposed. Then a rim was built at the top, and at least $\frac{3}{4}$ inch thick, before the sides were started. The nest building then progressed from the top to the bottom. There were willow and buffalo-berry bushes at the margin of the area, where the blackbirds perched for a large part of the time.

Contents of these nests and 2 others in a neighboring marshy area, on 3 separate visits are indicated in the following tabulation.

	June 6	June 10	June 15
1.	5 eggs	5 eggs	5 eggs
2.	empty	empty	empty
3.	2 eggs	-----	-----
4.	4 eggs	6 eggs	6 eggs
5.	3 eggs	5 eggs	5 eggs
6.	incomplete	incomplete	incomplete
7.	5 eggs	5 eggs (hatching)	5 young

A nest was found on June 14, 1933, on the ground in a pasture just below (east of) the house at Millett. It was on a slightly raised grassy ridge surrounded by wet ground. Materials in the nest were mainly grasses, with a lining of black horsehair. Diameter of the rim inside was 9 by 10 cm. In the nest were 2 eggs and a recently hatched young bird. Two young, dead and just outside the nest, evidently had been thrown out accidentally by the parent when leaving.

In early June, 1930, Brewer blackbirds were numerous about the meadow on Kingston Creek. On June 8, about 6 old nests but no occupied ones were seen in bushes on the cañon wall above the west side of meadow. On June 10, a small group of 4 or 5 individuals was seen early in the morning to arrive at the meadow from some point farther down the cañon. Near the ranch at the mouth of the cañon many adults were seen carrying insects for young on June 20. A young bird out of the nest was seen here on June 17.

On the meadow at 7300 feet at least 6 males were seen on June 14 (Miller). A nest containing 6 young was found in a 4-foot sage bush hanging out over the roadway. The nest was 6 feet above the road and in plain view. The young were about a week old—feathers of the ventral tracts were beginning to break through and show the black color of the juvenile plumage. The young responded to the presence of a person by begging for food. Only the male parent was seen, and it was not especially demonstrative.

From September 4 to 7, 1931, just after sunrise each morning a flock of about 50 Brewer blackbirds flew down the valley over the tops of the trees close to Kingston Creek. Each evening a similar-sized flock flew back up the creek. Once or twice the group perched for a minute or two in the trees close to our camp at 7000 feet.

A small colony of blackbirds was watched, beginning June 20, 1930, about the meadow and in the sage on adjacent slopes at Birch Creek, 7000 feet. When, at 6:30 p.m., a Cooper hawk flew over the meadow, about 50 blackbirds flew after it with loud cries. The hawk stopped in a tree on top of a ridge and the blackbirds continued to fly about it. A group pursued it again when it left that perch.

On the steep, northwest-facing slope bordering Birch Creek meadow the blackbirds were nesting in sage bushes which averaged 3 to 6 feet high. About 12 nests were seen in walking less than $\frac{1}{4}$ mile across this slope. The nesting bushes were 25 to 100 yards up from the margin of the meadow which was still wet and boggy. Half the nests found were old ones of previous years. Two at least had been built that season but had not held broods of young. The birds were giving alarm notes all the time I was in the vicinity. Red-winged blackbirds were also present, but no nest of that species was seen. On

June 22, a young blackbird was seen just out of the nest. Old nests built by this species were found also in sage brush south of the meadow.

When this vicinity was visited on June 26, 1931, a few nesting pairs of blackbirds, but not more than half as many as had been there the previous year, were nesting at the same place. Adults were seen gathering food for young on the open grassy ground close to the margin of the meadow. When I walked near the nesting area, several adults protested. A small group of about 20 individuals foraged about this meadow daily between August 29 and September 2, 1931.

On June 23, 1931, about 50 Brewer blackbirds were seen on a meadow near the mouth of Big Creek Cañon. They were mostly in a rather open flock in willows and on adjacent open ground. Several young ones were out of the nest but not yet completely feathered. Adults protested loudly when their ground was invaded.

Adjacent to South Twin River and below where it leaves the mountains, we studied 2 separate colonies of Brewer blackbirds. The upper one of these was in an alfalfa field, and the birds nested in cavities in the sides of hay stacks. Notes upon these nests were made on June 5, 1933, by Compton. The first stack examined contained 5 nests, as follows.

1. Eight feet from the ground on south side of the stack, constructed of grass and small twigs of sage brush and rabbit brush, lined with black horsehair. Inside diameter, 100 mm.; outside, 140 mm. About 5 inches overhang of hay. Contents 5 eggs.

2. On west side of stack, lined with black horsehair. Contained a single egg, spotted with egg yolk, and cold. Apparently deserted.

3. On north side of stack, 4 feet from the ground. New but empty, constructed mainly of old mildewed alfalfa twigs, lined with black horsehair. Inside diameter 95 mm.

4. On east side of stack, 5 feet from the ground. Constructed of alfalfa stems and weathered or frayed hay or straw; lined with black horsehair. Inside diameter, 90 mm. Contents 6 eggs. Incubating female allowed approach to within 4 feet.

5. On south side of stack, 4 feet from ground. Made of alfalfa stems and weathered straw; lined mainly with black horsehair but with a scattering of white and brown. Inside diameter 95 mm. Contents 4 eggs.

The second stack, 45 feet east of the first one, contained 1 nest, 6 feet above the ground. It held 3 normal eggs and 1 very thin-shelled one. Two or 3 forkfuls of hay had been taken from directly beneath the site, leaving the nest barely attached. The eggs were cold and seemed to be deserted.

The third stack was half a mile west of the other two but in the same field. In it were 3 nests as indicated below.

1. On north side of stack, 5 feet from ground. Constructed of old alfalfa twigs and lined with fine grass and horsehair, the latter black and restricted to the bottom of the cup. Inside diameter, 95 mm. The roof of hay projected about 10 inches over the nest. Contents 6 eggs. Female brooding.

2. Ten feet above the ground, apparently new and occupied, but not examined.

3. Five feet from the ground. Construction similar to first one, horsehair restricted to bottom of cup. Inside diameter, 95 mm. Contents 5 eggs. Female on nest.

Around all 3 stacks were fences which were used by the blackbirds for perching. Another stack, out in the middle of the field away from the stream, had no enclosing fence and no blackbirds nested in it.

The other colony of nesting Brewer blackbirds in this vicinity was close to the stream just below the alfalfa field. The 6 nests found here on May 27, 1932, were all in sage bushes about a foot above the ground and close to water. Two of them contained 6 eggs, three contained 5, and one was empty. Two of the nests were heavily lined with black horsehair. Six males flew up together and perched in tops of bushes near the nests.

On June 1, 1933, a nesting colony was found at this same place. Three nests were studied here as follows.

1. In sage bush 30 inches high and 4 feet across. Nest rim 16 inches above the ground, inside diameter 90 mm., outside 200 mm. Made of sage stems, lined with fine stems, horsehair, and rootlets. Site on east side of bush which was 20 feet from water. Contents 5 eggs. Brooding female left when I came within 1 foot, fluttered off and moved along the ground with slightly impeded flight for about 15 feet. Later it protested with others from the tops of bushes 40 to 60 feet away.

2. Same height from ground as last, on east side of scraggly sage bush, 3 feet from the stream. More compactly built than last with more fine materials in walls. Also less shaded. Five eggs in set. Brooding bird acted almost exactly like the first one had.

3. In center of sage bush 30 inches across and 20 inches high, 12 feet from stream. Rim 15 cm. above ground, inside diameter 10 cm., outside 17 cm. Walls thinner than in other two. Set contained 6 eggs. Brooding female flew off when I was 3 feet away. Two of these eggs had hatched when examined on June 9.

The details of nesting of Brewer blackbird just reviewed along with our other observations give basis for comparison of this species with other kinds of blackbirds in the region, especially red-winged and yellow-headed blackbirds. Some of the more interesting, to me, of these features are as follows. In the first place the greater range of choice in nesting site and the comparative freedom from restriction to marshy vegetation contrast with the habits of those marsh-dwelling relatives. The structure of the nest itself revealed a decided choice for dark materials in the lining. This was most often fulfilled by the use of black horsehair; the amount used apparently depending largely upon availability of that material. This color closely matched the dark color of the down of the young. Both these features contrasted with the light nest lining and whitish down of the red-wings, and they seemed to be correlated with the type of nest location characteristic for these species. The adaptive value of these sets of characteristics seems to be obvious.

Another trait in which this species contrasted with its 2 relatives was in the make up of the colonies. All 3 species were markedly colonial in nesting, but although the red-wings and yellow-heads were observed to be regularly polygamous in this region the Brewer blackbird colonies in every instance were made up of equal numbers of males and females. Further, the members of these pairs exhibited such close attachment for each other that they were nearly always together during the nesting time. Even when members of a colony were assembled into a flock, it was always obvious that this was an assemblage of pairs rather than of individuals.

Molothrus ater artemisiae Grinnell

Cowbirds were present in summer in the lower valleys of the region but in small numbers. Observations were made on this bird at the mouth of Kingston Cañon, 6000 feet, and in Smoky Valley, 5 mi. SE Millett. At the former locality several males were seen on June 17 and 20, 1930, in small trees about the fields. In 3 seasons the first cowbirds in Smoky Valley were noted as follows: May 13, 1930; May 29, 1932; May 25, 1933. These seem to be rather late dates, but in each season watch was kept for the species several days before it was seen. Holt (MS) noted one on May 5, 1915, on Moore's Creek, Smoky Valley. In 1932, at least, the arrival of cowbirds appeared to correspond with the arrival of cattle that had been driven from their winter range about 40 miles to the southward. In 1931, no cowbird was seen in the period, August 29 to September 11, when field work was carried on in the Toyabe region.

During late May and early June cowbirds were found as single birds, in pairs, or in small flocks. A male and female perched near each other in a buffalo-berry bush were killed with 1 shot on May 19, 1930. The female contained ova nearly grown; testis length in the male was about 10 mm. On June 3, 3 birds, apparently all males, were seen together in a bush, pointing their bills upward and going through display antics. A male was seen May 28, 1933, displaying before a female in the top of a bush. The male sang several times. Courtship activity was noted again at 7:30 a.m. on May 29, 1932. The male and female were in a dead branch above the general level of a rose-willow thicket. The male sang and flew at the female which moved 2 or 3 times and then flew away, the male following.

A cowbird egg found in a yellow warbler nest on June 15, 1933, was the only one seen in the region.

Piranga ludoviciana (Wilson)

Trees constituted the most obvious requirement for the presence of western tanagers in the Toyabe region. Mountain mahogany, of all the kinds available, seemed most suitable for this bird. This conclusion was reached mainly on account of the greater number of tanagers observed within the groves of mountain mahogany. Whether this apparent preference was the result of some especially favorable qualities in this 1 type of tree or of a suitable combination of physical factors in the environment was not determined. It seems a safe assumption that both were important. Other kinds of trees were visited in the daily life of a tanager. Among these were piñon pines, aspen,

birch, apple, willow, cottonwood, and buffalo berry. The last was frequented mostly during migrations.

Although during migrations tanagers were to be found at any spot within the whole area, the summer birds were restricted to the mountains and mainly to the upper slopes and ridges. On several occasions behavior of individuals in selecting perches in exposed, sunny places seemed to suggest a definite effort on their part to avoid the cold. This was separate from the tendency, also marked, for singing males to select exposed perches on leafless twigs.

Time of arrival in spring was late. On May 24, 1930, the first one for that season was seen with a group of small transient birds at 8200 feet on Wisconsin Creek. The earliest tanagers in 1932 and 1933 were recorded in Smoky Valley, 5 mi. SE Millett on May 22 and May 24. Latest spring records at that locality, for the same 2 years, were May 27 and May 28. Two fall records were for September 1 and 4, 1931, at Birch and Kingston creeks.

Hedymeles melanocephalus melanocephalus (Swainson)

One of the less common summer resident birds in the Toyabe Mountains was the black-headed grosbeak. The following record of observations shows the nature of occurrence of the species so far as determined.

On May 25 and 28, 1933, single males were seen in willows in Smoky Valley, 5 mi. SE Millett. These may have been newly arrived nesters or transients. Near the mouth of Summit Creek Cañon a female was seen on May 26, 1933, in a large thicket of willow, rose, and buffalo berry. On Wisconsin Creek a singing bird was seen on June 4, 1932, in birches at 7000 feet. On June 8, 1933, a male was singing in a mountain mahogany near deserted houses at 7000 feet in the cañon of South Twin River. When disturbed at 9 a.m., this bird flew up slope to a piñon pine. On June 20 and 21, 1933, one was noted singing morning and evening close to the mouth of the cañon of North Twin River. Only 1 bird was detected in the whole valley, probably only 1 pair was present. Farther north, on Kingston Creek, this bird was noted, June 10 to 20, 1930, rather frequently from the lower limit of trees along the water up to around 8000 feet. Birds at higher altitudes were in mountain mahoganies on the steep slopes. At lower levels they were mainly in birches, aspens, chokecherries and willows, although some were seen in piñons at least $\frac{1}{4}$ mile from the stream. The latest fall record is of an individual seen, August 31, 1931, in an aspen grove at about 7500 feet near Birch Creek.

Passerina amoena (Say)

The lazuli bunting was one of the late arriving summer resident birds in the Toyabe region. The earliest record is by Holt (MS) who saw one in Pablo Cañon on May 15, 1915. In 1932, a male was singing about noon on May 21 at the side of the road, 2 mi. N Darrough's. The earliest male noted 5 mi. SE Millett was shot, May 26, 1932, as it sang in the top of a buffalo-berry bush. On May 27, singing males were seen below the mouths of the cañons of North and South Twin rivers. All the remaining notes for this bird were made in June.

The main habitat of this bunting was in the thickets which lined the

streams and bordered the fields close below the mouths of the cañons. Below this the birds occurred, but in smaller numbers, out to the limit of trees, even to the center of the main valley on either side of the mountains. Upward, pairs were spaced regularly along the streams through the gorges, or up to about 7000 feet. The most conspicuous plants on this ground and the kinds most frequently involved in this bird's activity were willow, rose, birch, chokecherry, cottonwood, aspen, and buffalo berry. All these were either tall shrubs or trees, and usually they grew close to streams. The factors of seeming greatest effect in attracting lazuli buntings were the dense bushy growths for feeding and nest locations and the high points which provided unobstructed views of, and from, singing perches. The dead upper parts of cottonwoods and willows were favorite singing perches. Open water may have been an attracting element, but it certainly was of less importance directly than with such birds as the song sparrow or fox sparrow.

On June 18, 1930, a male was found singing in the tops of birches close to 7000 feet on Kingston Creek, and a female carrying nest material was watched in a streamside thicket at 6600 feet. The latter came near me and dropped the material but soon returned and picked it up again and then moved up through branches of a birch. It dropped the material again, this time to pick off caterpillars from leaves and eat them.

On June 17, 1930, the males near the mouth of Kingston Cañon were in constant song, usually singing from the tops of willows. Many females were seen perhaps indicating that the birds had not as yet started sitting (Miller). On June 21, 1933, along North Twin River, only males were seen. This gave basis for the supposition that all the females had eggs and were on nests. Ridgway (1877, p. 490) on July 4, 1868, found a nest containing 3 eggs near Austin, in a wild-rose brier along a stream in a cañon.

Carpodacus cassinii Baird

In the Toyabe Mountains Cassin purple finches inhabited groves of large aspens, but they also occurred in mountain mahoganies and in limber pines. Most of the recorded occurrences were above 8000 feet. More definitely, they were in Birch Creek, Kingston Creek, Wisconsin Creek, and Mohawk Creek cañons. Miller made note that the song in this locality was not different from that heard in the Sierra Nevada and Cascade Mountains.

Carpodacus mexicanus frontalis (Say)

House finches were scarce in the Toyabe region, or, rather, they were common at few of the localities where extended observations were made.

At Austin, toward the end of June, 1930, an old nest was seen beneath the roof of a porch, and at least 3 males were heard singing about the house (Miller). On April 28, 1930, a single individual was seen shortly after noon about the buildings 5 mi. SE Millett. Evidently this was a wandering bird since it was not seen again. In 1931, on September 8 and 9, a few house finches were seen in buffalo-berry bushes in this vicinity. A flock was seen about Peavine Creek ranch on May 21, 1932.

Largest numbers of house finches were seen on the steep, rocky walls of

the lower part of Kingston Cañon (June 18, 1930) and about the ranch at the lower end of that cañon. In early September, 1931, groups of 10 to 30 birds came and left frequently during 2 hours spent 1 morning in the apple orchard there. We heard repeated complaints of the damage done to fruit on the ranch, but within a few minutes we were told by the same person that the fruit, except for a small amount, was never picked. Most of it was left on the tree to fall to the ground as waste. At that time the ground was covered with fallen fruit. Many of the birds had been shot by the rancher in an effort to protect this crop which he had no intention to harvest!

Spinus pinus pinus (Wilson)

A small flock of pine siskins was seen on the morning of August 29, 1931, in a clump of willows in the meadow at Birch Creek, 7000 feet. One of these birds, a female, was obtained for a specimen. On September 2, 1931, several individuals were seen in aspens at 7500 feet on Birch Creek. On May 21, 1932, several were seen in a small flock in cottonwoods about Peavine Creek ranch, in the southern part of the Toyabe Range.

Spinus tristis pallidus Mearns

On June 20, 1930, an adult pale goldfinch was shot near the mouth of Kingston Cañon, 6000 feet (Miller). This individual was feeding at the side of the road in company of other goldfinches. A single individual was identified, September 10, 1931, perched in the top of a willow clump, 5 mi. SE Millett, in Smoky Valley.

Spinus psaltria hesperophilus (Oberholser)

Green-backed goldfinches were found in small numbers in the Toyabe region. A specimen was obtained, August 30, 1931, on Birch Creek, 7000 feet, and two, June 14, 1930, and September 4, 1931, on Kingston Creek, 7300 and 6000 feet. Sight records of others are mainly along Kingston Creek, between 6000 and 7500 feet, and in June and July. Usually the birds were close to the creek in aspen, cottonwood, willow, piñon, chokecherry, or apple trees. Even into late June these birds were found in small flocks rather than completely segregated in pairs.

Oberholseria chlorura (Audubon)

The green-tailed towhee was one of the most numerous summer resident birds in the Toyabe Mountains. This species occupied medium-sized shrubs (2 to 4 feet high) all over the range. It was more frequent in the higher parts of the mountains than at lower levels, probably on account of more favorable forage conditions at the higher altitudes. Nearly all the individuals of this species lived in sage brush, but in the more thrifty stands of that bush.

Earliest record of a green-tailed towhee in spring was on May 1, 1930, when one was seen close to South Twin River at 6000 feet. Out in Smoky Valley, 5 mi. SE Millett this bird was present mainly, if not solely, as a transient. One was obtained there on May 17, 1930. At 8:30 p.m. on May 17, 1932, in the same neighborhood one was disturbed from a roosting place

about 2 feet above the ground in a medium-sized clump of rabbit brush. Another individual in this vicinity was seen on May 25, 1932.

During the first week of June, 1932, camp was made on Wisconsin Creek, 7000 feet. Most of that time was stormy with cold winds and snow or rains. On June 6, about 10 green-tailed towhees were seen and heard within a few minutes in the sage brush close to the stream below the mouth of the cañon. Judging from the scarcity of the species in the mountains during the previous 2 or 3 days and the concentration of them at this place in the tall sage, it seemed evident that they had moved down out of the mountains to escape the storm. In fact several individuals had been seen in rapid, direct flight past our camp and downward.

On June 12, 1930, this was the first species heard in song near Kingston R. S. One was heard at 3:30 a.m. (Miller).

A female containing a fully grown egg, without shell, was taken on June 13, 1930, on a high ridge near Kingston Creek (Lamb).

A nest was found, June 13, 1930, near Kingston Creek at 8800 feet. It was 36 cm. up to rim, in a small thicket of sage and *Symphoricarpos* 30 inches high on a north-facing slope. Leaves on the bush were not out fully. The whole slope was covered with a similar growth. Three eggs made up the set. The brooding bird slipped quietly off the nest and moved close to the ground through the opposite side of the bushes. The nest was small, but loosely built. Its height was 11 cm.; outside width 8 cm. Inside diameter at rim was 55 mm. The lining was partly of black horsehair. A nest found June 12, at 7500 feet in the same cañon was 2 feet up, in a sage bush at the side of a trail. It contained 4 eggs.

A nest whose rim was 8 inches above the ground in a low sage bush of twice that height on the floor of Birch Creek valley about 7500 feet contained 2 eggs and 2 recently hatched young on June 24, 1930. The bird flew off the nest when I walked near it on a trail.

Exactly 1 year later a nest was found near Big Creek. It was 1 foot above the ground in a sage bush and held 3 eggs. The brooding adult flushed when approached within 10 feet. On June 29, 1931, a nest containing 3 small young was found 1 foot above the ground in a bush in Mahogany Cañon. The brooding adult flushed silently when disturbed.

Pipilo maculatus curtatus Grinnell

The small numbers of Nevada towhees present in the Toyabe region were restricted to the type of vegetational cover which bordered the streams from a little below the mouths of the cañons up to about 8000 feet. Here the dense tangle of bushes and vines along with the less frequent tall shrubs and trees provided the leaf litter for ground foraging, the thick cover for hiding, and the exposed open perches for singing posts, all of which seemed to be important in the life of this bird. This kind of habitat was so restricted in area that comparatively few individuals of the bird could be accommodated.

On June 19, 1930, a male was heard singing in sage brush near a small clump of aspens in Kingston Cañon, 7100 feet. The song was decidedly different from that of the mainland Californian races. The trill was weak and

short and was preceded by 3 or 4 short, burred notes similar in quality to the notes at the end of the song of the Lincoln sparrow. The first impression was that of an unusual green-tailed towhee song (Miller).

On May 25, 1930, a nest was found near Wisconsin Creek at 7800 feet. It was on the ground beneath a small sage bush close to a spring. The nest rim was slightly above the ground level, and the site was shaded and screened from above. The brooding female flew off quietly and hurriedly when approached; it left without making a sound. There were 3 eggs in the set. After the female was caught in a mouse trap this nest was deserted: evidently the male of this species takes no part in incubation (Lamb).

Another nest was found on June 18, 1930, close to Kingston Creek, 6600 feet. It was settled among sprouts on a main trunk of birch at a height just even with my head. The site was at the side of a road and was shaded by birches. The brooding bird did not flush until after I had stood beside the nest for several seconds. It then flew to the ground and moved off hesitatingly through the brush. The outer part of the nest showed a large proportion of wide strips of bark. It held 4 eggs. There were birches for about 30 feet in every direction as well as some brush and small bushes, and the ground was covered with leafy litter. An old nest lower in the same clump appeared to be one used by towhees in an earlier season.

Passerculus sandwichensis nevadensis Grinnell

Savannah sparrows were numerous summer residents in Smoky Valley where they inhabited the moist pasture lands, the alfalfa fields, and the marshy areas close to springs. The main factor favoring their presence locally seemed to be a dense cover of low vegetation. Nearly all activities of this species took place close to the ground although perches on tall bushes or posts were used when available. Most situations of this sort in the Toyabe area were associated with wet ground, but the moisture in itself may have had little part in attracting the birds; it was necessary to enable the plants to grow.

Several times, as on May 15, 1932, these sparrows were seen feeding on flying insects which they caught late in the morning after the air became warm.

Two individuals that were watched for about 5 minutes in the morning of April 22, 1930, were thought, at first, to be a mated pair. They were in grass and sedges along a shallow stream through a pasture where plants were under 4 inches in height and where there were frequent small mounds. The birds kept near each other for the whole time, being never more than 10 feet apart and usually within 3 feet of each other. They were feeding and both were singing, usually, alternately. They moved by ducking the head and running or hopping through the grass or by short, low flights. One, at frequent intervals, would raise 1 wing slightly and quiver it, but no response was detected on the part of the other bird. Both birds were shot and they proved to be males. Many were heard singing, especially in the evening just before dark when they were heard in every direction on the wetter parts of the open pasture.

At 11:30 a.m. on May 16, 1930, a Savannah sparrow was flushed from

a nest on the ground in the center of a grass clump 8 inches high. It was near the center, but in a drier part, of a marshy area 5 mi. SE Millett. The surrounding alkali ground was covered with water in all depressions and everywhere except in a few small raised places. The vegetation in every direction was only sedges and grasses. The bird fluttered off when I was 2 steps away and kept near the ground, half running and half fluttering, for 30 yards when it stopped. The 4 eggs in the nest were partly shaded by grass. This nest was empty on June 3, but birds were chirping anxiously from near-by perches. Scales in the nest indicated that a brood had been reared.

A nest found on May 30, 1932, was on a hummock of grass and sedges in a marsh 4 mi. SE Millett. Its rim was 6 inches above the water surrounding the hummock. The nest was an open cup on the ground, beneath a sloping bunch of dead sedge stems which hid it completely except on the northeast where it was open. The brooding bird faced this opening. I forced the bird off the nest 3 times before I could be sure of its identity. The first time it flew 75 yards to the northeast just as I stepped on the mound. A few minutes later it circled and uttered alarm notes. The next time at a second disturbance it flew close to the ground but for a shorter distance to the east where it dropped into the grass. The third time it flew toward the south, but did not leave until I was within 2 feet of the nest. There were 4 eggs in the nest. On June 7 there were only 2 eggs, and no bird was seen near it.

In the midmorning of May 25, 1933, a Savannah sparrow was seen carrying nesting material from a marshy area to the drier margin. Three trips were made in quick succession to the same place and the bird left from there each time, but I was unable to find the nest. A more careful search on May 28 revealed the nest which held 1 egg although no bird was seen. The nest was completely roofed by the thick cover of dead grass of a previous year. The grass stems that had been dropped in a small tunnel leading to the nest from the northeast gave a clue to its location. The lining was of fine grass stems and a few black horsehairs. At noon on May 30 there were 3 eggs. The nest was examined on June 4. In the interval it had been stepped on by a horse and completely smashed. All the eggs had been broken into many pieces.

Another nest found on June 11, 1933, was on moist alkali ground at the margin of a marsh in the same vicinity as the last. It was about 25 feet from clumps of wild rye, in dead grasses and sedges, but not in a heavy growth. There was a thick deposit of white salts on the ground. The nearest bush was a small rose 50 feet or more to the south. The brooding adult flushed off over the marsh for more than 50 feet. The nest had no roof, but it was slightly screened by dead grass stems. There were 3 eggs. Two birds chirped in protest from near-by bushes.

Early in the morning of June 16, 1933, a Savannah sparrow was flushed in this same pasture; it ran through the grass with widely spread wings, and so distracted my attention and deceived me that I lost the exact location and was unable to determine whence it started. No nest was found although the behavior of the bird indicated that one was near.

A bird was seen on May 29, 1932, fluttering along the ground as though coming from a nest (Orr). A close examination revealed a small hole in a clump of sedges in a small meadow near a spring. This was in the same general vicinity as the other nests. The nest here was constructed of small grass stems and was lined with horsehair. It held 3 young with eyes closed and bodies naked except for a few bits of down, as well as an unhatched egg. The bird stayed hidden in the grass, but a few calls were heard from it. On June 7, the 4 young birds in this nest were nearly completely feathered. They watched the disturber but did not open their mouths. Both parents stayed near them.

Another nest in this neighborhood found on June 15, 1933, contained 4 eggs. The location and structure were similar to others. The lining was partly of black horsehairs.

Poocetes gramineus confinis Baird

The open ridges along the crest of the Toyabe Mountains, above 9000 feet, were inhabited in summer by vesper sparrows. On June 14, 1930, a male was shot, at 9200 feet, on a ridge south of Kingston. This bird, testis 13 mm. long, was singing from the top of a bush. Evidently it was established on its nesting ground. Several other birds were singing from the tops of sage bushes in the same vicinity. All of them were wild and difficult to approach. On May 28, 1898, Oberholser obtained a female on Arc Dome.

In both spring and fall, transient individuals were found on open ground in Smoky Valley, SE Millett. Dates of these records are April 24, 1930, and September 8, 9, and 10, 1931.

Chondestes grammacus strigatus (Swainson)

Lark sparrows were detected at several localities in the Toyabes but no nests were found. On the floor of Smoky Valley, 5 mi. SE Millett, single birds, pairs or small groups were seen on April 24, 27 and 28, and May 13, 1930, and May 18, 19, 20, 21 and 23, 1933. These were usually on the bare ground about the corral and buildings there, but a few were out on pasture land where there were scattered bushes. At Millett a single bird was seen, June 14, 1933, in a dead bush along a fence.

About the deserted ranch at the lower end of South Twin River, 6000 feet, this species was noted frequently in May and June. Here the bare or rocky ground close to fences, buildings, scattered bushes or small trees seemed to provide the attractant features.

On August 31, 1934, several lark sparrows were seen on the floor of the valley of Birch Creek, 7500 feet. They were on dry, open ground, with a few scattered groups of willow and birch. Along Kingston Creek, on September 4 and 7, 1931, lark sparrows were seen at 6000 feet, on open ground of a pasture.

Here is a bird which seems to require for foraging ground bare or nearly bare but with a perching place off the ground conveniently near. Even the perches show some quality of openness, for fences and buildings serve as well as trees. Individuals seem always to keep themselves where they can see

any approaching danger. They depend more upon their powers of flight for escape than upon concealment.

Amphispiza bilineata deserticola Ridgway

Not a single black-throated sparrow was seen in the Toyabe region until 1933. In that year the species was found to be fairly common on the drier parts of the desert south of Millett, from the center of Smoky Valley to the base of the mountains. The same ground had been worked in previous years and special search had been made for this bird without finding it. However, since Oberholser and Bailey (MS) had noted its presence in early May, 1898, in the neighborhood of Peavine Creek, this sparrow must be considered as a regular summer resident in Smoky Valley.

The first individual discovered in 1933 was taken, May 26, near the mouth of Summit Cañon.

A singing male was watched June 1, 1933, on the desert near South Twin River, 6000 feet. It and its mate were seen to go to a sage bush about 15 inches high where there was a nest partly finished. Although the birds were not disturbed by a close approach, they deserted the site and added no more material to the nest. Surrounding this site were scattered bushes of sage, *Tetradymia*, *Atriplex*, and *Sphaeralcea* with much bare, gravelly ground intervening.

On June 2 at least 5 pairs were seen on a short stretch of the desert. Over the same ground on June 5, 4 individuals were found, singing from the tops of bushes under 2 feet in height. Since only 1 bird was seen at each place, it was thought that incubation must have started.

Two birds watched on June 9, 1933, apparently were nesting although no nest was found. They seemed to stay in an area 250 feet square, but they did not attempt to drive other species from it. Later in the morning an egg was found hanging in the branches of a small spiny bush. It was fresh, for the contents that had spilled from it were not yet dry (Compton).

A nest found on June 9 was 22 cm. to the rim in a bush of *Grayia spinosa* 10 inches high. The site was surrounded by low bushes of the same kind on gravelly soil between 2 belts of sage. The nest rim measured 55 mm. inside and 95 mm. outside. The structure was made of whitish material and was lined partly with black horsehair. It contained 4 bluish unmarked eggs. The brooding bird flew off when I was still 15 feet away. A few minutes earlier an individual thought to be the male of the pair had driven a sage sparrow from a sage bush 20 feet from the nest site. The 4 young had hatched by June 18. An adult was brooding at 6 a.m. and was carrying food toward the nest at 8 a.m.

Two-hundred yards to the west of the last-described nest and in the same kind of bush a second one was found on June 18. This one was 30 cm. from ground to rim and was halfway to the top of the bush. About half the branches in the bush were dead. The soil was composed of coarse gravel and small rocks. An adult bird flushed from the nest when I was still 20 feet away. There were 4 young with feathers ready to break their sheaths, but on

them the grayish-white down was still showing. The nest was composed of fine material—grass blades and stems, *Eriogonum*, and small twigs. The lining was whitish. The exposure was mainly to the east, but slightly to the south, and the nest was partly in shade.

On the same day another nest containing 4 young was discovered below the mouth of North Twin River Cañon. These young birds were not more than a day old and showed a very fluffy, slightly grayish, white down on their feather tracts. An adult was flushed from the nest at 8:25 a.m. and 20 minutes later one was seen carrying food toward the nest. The nest was 10 inches above the ground in a sage bush in a small wash. The surrounding vegetation was almost entirely of sage brush. The nest was composed of twigs and fibers of sage brush, and it was lined with light colored rabbit fur. The site was on the northeast side of the bush (Compton).

Amphispiza nevadensis nevadensis (Ridgway)

Sage sparrows doubtless were resident in Smoky Valley, although our records of the species are all between April 21 and September 10, the approximate seasonal limits of work in the area. Throughout the bush-covered desert well up to the base of the mountains this was a common and widespread species.

Sage brush was a conspicuous feature in the habitat of this sparrow, but other kinds of bushes were occupied sometimes. The birds seemed to spend most of their time on the ground or in the lower parts of bushes, coming to the bush tops or to the wires or posts of a fence to look about or to sing. One bird, when perched, flipped its tail upward at frequent intervals. Another perched with its body upright and its tail projecting almost straight downward. Requirements of this bird seemed to be somewhat intermediate between those of the Brewer sparrow and the black-throated sparrow. Apparently it inhabited situations drier and warmer than the usual ones occupied by the former but not so warm or dry as ones occupied by the latter. This general relationship appears to hold also when the whole ranges of the birds are considered.

A nest was found, May 26, 1932, beneath and near the center of a small rounded sage bush on the desert 5 mi. SE Millett, in Smoky Valley. The bush was only 1 foot high. When discovered at 8:30 a.m., the bird at the nest flushed as I walked within 4 feet of it. It fluttered slightly and moved off, close to the ground, half running for 10 feet and then running for another 10 feet. It stayed within 25 feet of the nest for 3 or 4 minutes and then flew off to the north. During this interval the bird was quiet most of the time. It began to feed as it walked over the ground, part of the time picking off objects from the lower leaves of sage bushes.

For a part of the time it perched in the tops of small sage bushes. Then it would twitch its tail upward quickly and for a short distance. Off to the northwest about 100 yards a bird thought to be the male of the pair was singing. The surrounding bushes were mostly sage, and they varied in height up to 3 feet. There were a few *Chrysothamnus* and about an equal number

of *Sarcobatus*. The soil was sandy but hard and cracked slightly. There was some cover of grass.

The nest when discovered contained 2 eggs. The following evening, May 27, the set of 3 eggs had been completed. During the incubation period several visits were made to the site and variations in the behavior of the brooding bird were noted, as follows. At 5 p.m. on May 28, the bird would not leave when the bush was hit with a stick, or when I stooped low over the nest. Finally when the bird was forced off, it ran off to the northwest, for about 25 feet on the ground with tail elevated, and then it flew. The strong wind may have had something to do with this reluctance to leave. At 3 p.m. on May 30, the sitting bird did not leave when I walked close to the site and then went back and bent low over the nest with my face only 15 inches from it. At about the same time of day on June 6, I had to shake the bush violently before the bird would leave. The following afternoon it left with less disturbance than previously. It flew after running about 25 feet in the same direction noted earlier. On June 8 no bird was on the nest when it was examined.

The last visit to this nest was made on June 9 at 9 a.m. As before, the brooding bird ran off 30 feet or so to the northwest, but this time it uttered soft cheeps and returned to perch on a bush 8 feet away. Fifteen minutes later the mate (male?) came and perched on a near-by fence post. Both birds were quiet when I left them. In the nest was a young bird holding its mouth open for food, one just hatching and with its head still within the cap (large end) of the shell, and 1 egg not yet hatched. Thus the eggs were hatching on the 13th day after the completion of the set. Apparently the incubation period in the sage sparrow is close to 13 days.

Near the lower end of North Twin River, on June 18, 1933, an adult sage sparrow was found feeding a bob-tailed young one on the ground beneath an *Atriplex* bush. This was within 50 yards of a black-throated sparrow nest. The young one was able to fly for as far as 3 feet. The parent moved about, jerking its tail upward slightly, as it picked up insects, within 10 feet of the young one. Another adult in the vicinity sang from the top of a sage bush 3½ feet high and then gave a long series of harsh notes which continued for more than a minute and sounded something like notes of an English sparrow.

Junco oreganus shufeldti Coale

At the margin of the meadow at 7300 feet on Kingston Creek an adult female Shufeldt junco was obtained on June 8, 1930. It weighed 18.5 grams and its ovaries were small, showing no sign of activity (Lamb). Evidently this bird was a stray that for some reason had failed to return to its summer breeding ground. When discovered, it was alone, drying its feathers, perched on a small bush at the edge of the meadow.

Junco caniceps (Woodhouse)

Red-backed juncos in the Toyabe region were birds of the mountains in the period we worked there. The nesting area included most of the mountains above 7000 feet. The birds were found most often along the streams and

at the seepy places, and on the ridges where there were trees—limber pines, mountain mahoganies, aspens, and birches. They were not often seen on the dry sage-covered slopes and ridges. And they were not restricted to the near vicinity of open water.

That juncos move down out of higher altitudes during snow storms was demonstrated repeatedly in early May, 1930. Near the mouth of South Twin River cañon juncos appeared in large numbers during each of several storms which came during our stay there. On April 30, many flocks of about 25 birds, as well as single birds, were seen in piñons, among sage bushes, and in the streamside vegetation at 6500 feet. About noon many were feeding on the ground where the snow had melted. Ova in females examined had scarcely started to grow; testes in males were 5 to 6 mm. long. The next day was warmer and fewer juncos were seen; apparently they were drifting back to higher altitudes. On May 4 and 5, after another snow, many flocks of juncos were seen. May 10, a bright day, none was seen at this camp.

Near Kingston Creek, on June 9, 1932, a junco was watched as it sang from perches in the shade 3 feet above the ground, on dead branches of mountain mahogany. The notes were in series of 3 to 10, and the series were from 5 to 10 seconds apart. Another on June 11 was singing 25 feet up in the top of a limber pine.

Miller decided that the song was shorter and had a more rapid trill than that of the species *oreganus*. One that he watched had a song which resembled the trill of a titmouse. At times, however, it changed to the characteristic song of the junco.

On a ridge near Wisconsin Creek a pair of juncos was watched on May 20, 1930, one of which was carrying a bundle of straws evidently for nesting material. It was followed closely by the other one. The 2 birds stayed in mountain mahogany and chirped nervously but did not go to a nest. This territory was at least half a mile from the nearest water. A female collected at mid-day on May 27, from a perch close to the ground in a rose thicket by a spring, had laid part of a set. It contained 1 egg 18 mm. long. This was the first individual found close to the stream at this camp. All the others had been on the dry ridges.

A nest containing 4 eggs was found on June 13, 1930. It was on the ground in a small patch of gooseberry in an open space in a grove of aspens at 9000 feet near the head of Kingston Creek. A large bank of snow lay near by. The brooding female flushed from the fresh eggs and left without a sound.

Near North Twin River, 8500 feet, a nest was discovered on June 19, 1933, by watching a junco for more than half an hour. First the bird appeared, from a willow thicket (10 a.m.) 100 yards away, in response to squeaks. It carried something in its bill which I at first thought was straw, but which later proved to be insect food material. It perched for about 5 minutes, gave 1 trill, then flew in a circle toward the nest location, perching twice for 5 or 10 minutes, until it came within 10 feet of the nest. Then it stood for a long time on logs and sticks and finally moved over the ground to the nest. It came out in less than a minute carrying a large excreta sac

which it ate within a foot of the nest. This bird, thought to be a male, then flew away.

I went directly to the nest which was on a south-facing bank and 10 feet from the water of a stream, 4 feet wide. The site was beneath a sparse thicket of sage and rose bushes under 2 feet in height. On the nest, perched on the rim, was the female which did not move until I came within a foot of the spot. Then it fluttered off with raised, spread wings and went across the stream and away, but it returned and uttered anxious chirps while I remained. In the nest there were 4 young, 2 or 3 days old, with dark, slate-colored down. One or two raised their heads and opened their mouths when I came near. Leading to the nest there was a trail of nesting material which the birds had dropped. A patch of snow remained where I first saw the male gathering food.

A nest found on June 20, 1933, was near the trail at the divide between North Twin River and South Twin River. It was on the ground beneath a small clump of sage and *Symphoricarpos*. The site was exposed to the south and was unshaded. It was in an opening, on level ground, surrounded by mountain mahogany. The ground was covered with small, broken rocks and was dry. It was nearly level. Thirty feet away there was a snow patch 6 inches high and about 20 feet across. The brooding adult flushed from the 4 eggs when I was yet 20 feet away.

On June 21, a nest was found on the ground in a grove of aspens at 7800 feet close to the same stream. It was beneath the dead base of a rose bush and surrounded by rose bushes. The site was shaded for a part of each day. In the nest the 3 young, 2 or 3 days old, were covered with dark-colored down. There was a single unhatched egg. The parent bird flew from the nest and perched for nearly 15 minutes before it flew directly to the nest again. At 9:30 a.m. the young juncos were holding their mouths open, apparently on account of the heat.

On Mohawk Creek, June 18, 1931, several individuals were seen in a family group among aspens, and a young one was shot that had been out of the nest for several days. On June 20 a family group of young birds with short tails was seen in sage bushes and a willow clump by the stream at 9000 feet. Adults chirped nervously near by.

Spizella passerina arizonae Coues

During the migrations chipping sparrows were found throughout the Toyabe region wherever there were bushes. They were then found in company of other small sparrows, especially Brewer sparrow.

In summer, chipping sparrows were more closely restricted to the vicinity of trees. In this region they seemed to be most numerous among mountain mahoganies. Many were seen also in aspen groves. A few that seemed to be established for nesting were found among various sorts of trees as far down as the base of the mountains. For instance, one was found in an old deserted apple orchard near the mouth of Summit Cañon on May 26, 1933. Other individuals were seen in limber pines and piñon pines. The majority of the nesting pairs appeared to be in a belt between 8000 and 9000 feet, but some

lived in trees near timber line. Steepness of the slope seemed to have little effect upon the desirability of a site for nesting.

Foraging took place usually on the ground conveniently near trees to which the birds invariably flew upon being disturbed. Chipping sparrows often fed side by side with juncos. If interrupted while feeding, individuals sometimes carried objects of food with them on their way to a safe perch; one was seen thus taking a caterpillar from the ground to a mountain mahogany.

Singing perches were most often in the tops of trees of medium height. One observer (Miller) noticed a considerable variety in the length of song of different males. So far as noted, however, the length was nearly constant for each individual. One singing male that was pursued by a person on foot would not move more than 75 yards in any 1 direction; it thus indicated the size of its nesting territory.

On June 15, 1930, a nest containing 4 eggs, far incubated, was found at 8000 feet in Mahogany Cañon, near Kingston R. S. The nest was 15 feet up in the bushy extremity of a vertical limb of mountain mahogany. The only bird seen near this nest proved to be a female.

Spizella breweri breweri Cassin

Probably more Brewer sparrows than any other kind of bird inhabited the Toyabe region in summer. Although this species was most abundant where sage brush grew in better than average stands, it was found also in other situations where bushes grew in fair stands. It avoided both the densest thickets and the nearly bare areas where the bushes were scattered far apart. Of all the birds in the region its habitat was nearest that of the sage thrasher and the sage sparrow, but there was greater diversity in the habitat of the Brewer sparrow.

During May most of the numerous Brewer sparrows seen in Smoky Valley, SE Millett, seemed to be migrating birds. On April 25, 1930, at 6 a.m. when I stopped an automobile in the center of a large open field one of these birds immediately lit on a fender. Then when I disturbed it by walking around the machine, it flew off across the field toward the north.

Brewer sparrows searched over the stems and foliage of the bushes in which they lived as well as over the ground for their food. In general, they were much more numerous in the tall sage close to streams than where they occurred in smaller bushes. Doubtless this is accounted for by a greater amount of available food among the bushes on the moist ground.

This desert bird showed no inclination to require open water within its habitat. However, when water was present, it was used for drinking and bathing.

Brewer sparrows were among the most persistent singers of all birds in the Toyabe region. Two birds were watched on the morning of May 25, 1932, 5 mi. SE Millett. One of them was feeding by picking objects from the stems and leaves of sage bushes. The feeding was interrupted regularly when the bird hopped to a high, exposed twig where it sang. At 1 place a singing individual was approached which indicated by its behavior that it had a well-defined nesting territory. It would move from perch to perch within

that territory, but I was unable to drive it away. After each flight it perched on top of a sage bush, and it moved over a territory of approximately 150 yards diameter. On each perch the bird continued to sing until it was disturbed again by too close approach. It permitted approach to within about 15 feet, or even less, as it came near the limits of its territory.

Feeding of a bird by another, probably its mate, was noted at 8:15 a.m., May 31, 1932. An adult bird was perched 4 feet above the ground in a buffalo-berry bush. A second individual flew to the same perch and fed the first one, which then shook its feathers and preened. No call notes were heard.

Near South Twin River, coition was noted twice within a few minutes about 7 a.m. on June 9, 1933. Each time, the female perched on a dead twig of a bush about 18 inches off the ground, elevated the tail, and uttered twittering notes, and the male came directly.

About 10 o'clock on the same morning a pair of Brewer sparrows was watched for 15 minutes. At first the birds were perched on a dead willow close to the stream bed. What happened next could not be seen clearly, but it appeared as follows. The female gave a mating note, whereupon the male came and mated, then a second call was given with accompanying posture. Another pair appeared and the new male mated, or attempted to, with the first female. Then the first male hurriedly drove off the intruder and the second pair left. After about 2 minutes the mating note was given by the female, and the male again came and mated. Soon the note was repeated and a second male again appeared and mated or tried to mate. The first male again rushed to drive the intruder away and pursued it for at least 50 yards. The first female merely moved to another perch 6 feet away. Next this bird picked up a straw, but dropped it and picked up the same or another one which it also dropped. Later it flew to sage bushes, possibly carrying nesting materials, accompanied by the first male. After that both birds moved among sage bushes, apparently foraging.

Record of nests of Brewer sparrow in the Toyabe Region:

Date	Place	Altitude	Site	Contents
June 9, 1930	Kingston Cr.	7500'	small sage bush	just begun
June 13, 1930	Kingston Cr.	7500'	18 in. up in sage	3 eggs
June 13, 1930	Kingston Cr.	8000'	30 cm. above ground	half completed
June 21, 1930	Birch Creek	7000'	12 in. up in sage	4 eggs
June 23, 1930	Birch Creek	7500'	75 cm. up in sage	4 eggs
June 21, 1930	Birch Creek	7000'	3 ft. up in sage	4 eggs
June 1, 1933	S. Twin River	6000'	10 in. up in sage	1 egg, 4 on June 5
June 1, 1933	S. Twin River	6000'	in sage	empty, 3 eggs June 5
June 1, 1933	S. Twin River	6000'	in sage	empty, 2 eggs June 5
June 1, 1933	S. Twin River	6000'	50 cm. up in sage	not completed, 2 eggs June 5, 3 on June 9
June 5, 1933	S. Twin River	6000'	28 cm. up in bush	3 eggs
June 9, 1933	S. Twin River	6000'	21 cm. up in sage	4 eggs
June 18, 1933	N. Twin River	6000'	40 cm. up in Grayia	3 eggs
July 4, 1868	Austin		in sage	3 eggs (Ridgway, 1877, p. 480)
June 5, 1915	Pablo Cañon			3 eggs (Holt, MS)

The nests listed above were remarkably uniform in several respects. With respect to site they were most alike. Although the actual distance above the ground varied slightly, the position of the nest in the bush was nearly the same. Sage bushes held the nest nearly every time, and when they were not used, some other kind, of similar form, was substituted. Time of laying was about June 1 at 6000 feet, about 2 weeks later at 7000 feet, and nearly 3 weeks later at 8000 feet. Completed sets nearly always contained 3 or 4 eggs.

Zonotrichia leucophrys leucophrys (Forster)

The white-crowned sparrow was found in summer in the Toyabe Mountains only once. On June 12, 1930, a single individual was watched for 2 hours in a willow thicket, at 9500 feet, near Kingston R. S. The willow was a variety of *Salix pseudocordata* (Anderson) Rydberg and this patch on a wet, north-facing slope was the only one found in the mountain range. The sparrow sang and moved about from perch to perch, but it eluded capture. None was seen at the place when it was visited on July 1, 1931. Judging from the behavior of this bird it seems likely that the species nests in small numbers on the Toyabe Mountains. Additional support is given to this supposition by 1 specimen, immature, but sex undetermined, which was obtained September 2, 1931, on Birch Creek, 7000 feet. The molt was not quite complete, several tail feathers were only partly grown. It seems doubtful that this bird would have made an extensive migration flight. These 2 records are the only ones for the mountains.

Seven specimens were obtained, September 8 to 11, 1931, on the floor of Smoky Valley, 5 mi. SE Millett. These were an adult male, 2 immature males, and 4 immature females. In each of these the molt apparently was complete.

Zonotrichia leucophrys gambelii (Nuttall)

The Gambel sparrow was found to be numerous as a transient throughout the Toyabe Mountains region. At Birch Creek, 7000 feet, an immature male was obtained September 1, 1931. Two adult females came from South Twin River, 6500 feet, May 8 and 10, 1930. Eight skins from 5 mi. SE Millett were taken, April 21, 1930, and September 10 and 11, 1931.

Passerella iliaca schistacea Baird

A male fox sparrow obtained, May 4, 1930, at South Twin River, 6500 feet, seems to belong to the race *P. i. schistacea*. It stands out among a large series from the Toyabe Mountains collected in summer by its much more reddish coloration. Weight was 30.2 gm. Wing length, 82.7 mm.; tail length, 83.4; culmen, 12.4. Although the date of capture is rather late for a transient of this species, this individual's color seems a certain indicator that it belonged to a northern race.

Passerella iliaca canescens Swarth

The habitats chosen by White Mountains fox sparrows in the Toyabe region served to emphasize the close relationship of this species to the song sparrow. Fox sparrows were more numerous in higher parts of the mountains and song sparrows in the lower valleys. But the area of overlapping was broad

and sometimes it seemed to cover the whole range. Evidently there was little difference in the habitat requirements of these species, as far as this mountain range was concerned. In other words, the environmental factors which, in other regions, separate these 2 birds were operating little if at all in the Toyabes.

There was a hint that fox sparrow habitats shifted, or became restricted, each year with the advance of the summer. Each year in the brushy areas 5 mi. SE Millett, fox sparrows were seen all through May. These birds were in places that appeared to be like the customary nesting places of the race. Moreover, their behavior was that of birds settled and preparing to nest. Presence of fox sparrows day after day in the same thickets, singing and defending the site from intruders gave the impression that they were on their nesting grounds. And this was exactly the time that the birds in the mountains were building nests. However, no nests were seen in Smoky Valley and later, in June, all these birds seemed to disappear. The solution of this puzzle awaits more conclusive observation, but a logical inference seems to be that the birds did take up territories, but when with the seasonal advance the sites became unsuited for nesting, they left. Changes that seem possibly sufficient to account for desertion of this area were the rapid drying of the air and, especially, the ground. This became noticeable markedly in late May; there is more satisfactory evidence that other birds (yellow-headed blackbirds) gave up nesting sites on account of it.

To illustrate manner of occurrence of these birds on the floor of Smoky Valley the following extracts from my notes may be useful. May 16, 1932. One singing in morning among close-growing thickets of rose, willow and buffalo berry. Ground moist. Perched on dead upper snags—highest under 10 feet above ground. This bird came, with an insect in its bill, in response to squeaks but soon resumed its singing. Another was singing off to the northwest. May 18.—Few minutes after 9 a.m. One singing 10 feet up in top of buffalo berry. Songs a little more than 10 seconds apart. Many rose and willow bushes near. A song sparrow singing 20 feet away. May 29.—At least 2 singing, 7:30-8 a.m., mostly on dead limbs of buffalo berry, projecting above dense thicket of rose, willow, buffalo berry. One came to the vicinity of song sparrow nest in response to chirps of parent when I was near. Singing at same place at noon. The thicket where these birds occur is more than $\frac{1}{4}$ mile across and it is practically impenetrable over most of the area. Some trails made by cattle can be followed by bending low.

Fox sparrows resembled song sparrows in their avoidance of the drier, more open slopes. The fact that the fox sparrows had their center of abundance at a higher level in the mountains seems to indicate a difference in the tolerance of the 2 species to climatic conditions. But the nature of the restriction remains uncertain.

Moist or, even, wet ground was the most obvious of the necessary elements in fox sparrow habitats in the Toyabe region. Along with the moist substratum the birds needed some sort of shrubby vegetation, and singing perches in exposed places 10 to 20 feet above the ground added to the desirability of the home sites. This type of situation occurred most frequently and most

persistently uniform through the summer about springs and seeps at the sources of streams from 7000 to 9500 feet. Kinds of plants which seemed most prominent in fox sparrow surroundings were birch, willow, rose, currant, *Symphoricarpos*, aspen, cherry, sage, buffalo berry, and ceanothus.

Frequent capture of this bird in mouse traps set on the ground in moist places indicated that much time was spent in such situations. Individuals were seen often foraging in the usual manner for the species; scratching with a rocking motion among leaves and leaf mold on the ground. That fox sparrows do not always feed in early morning was suggested by examination of a specimen obtained along Wisconsin Creek, 8000 feet, at 8 a.m., May 24, 1930. At that time, 4 hours after daybreak, this bird's stomach was completely empty. When first discovered, the bird was singing in the top of a birch, directly over the stream.

Miller noted that the "click" note of the fox sparrow in the Toyabe Mountains was much weaker than that of the races *stephensi* or *mariposae*, resembling more the *thop* of a junco or Tolmie warbler. It lacks the metallic quality of the corresponding utterance of *stephensi*.

Although singing perches were usually on exposed twigs above thickets, they were not uniformly so high. On some occasions individuals were seen singing on the ground. Sometimes the perches were within the bush so that the bird was practically out of sight.

Several instances were noted in early morning which seemed to show that these birds responded directly to the warmth of the sun. Certain individuals were observed to begin to sing as soon as the sunshine struck their perches. Here, warmth seemed more effective in initiating activity than light itself.

Record of nests of fox sparrow found in the Toyabe Mountains:

Date	Site	Contents
June 10, 1930	3 feet up in birch 7500 feet	3 eggs
June 13, 1930	6 feet up in birch	3 eggs
June 17, 1930	Base of birch clump	2 eggs—another egg in oviduct
June 18, 1930	120 cm. up in rose	2 young; unhatched egg
June 21, 1933	5 ft. up in large willow; 7800 ft.	2 eggs
June 21, 1933	1 foot up in rose 8000 feet	3 eggs

Four nests were found in 1930 in the Kingston Creek neighborhood. One of them, found June 10, near Kingston R. S., 7500 feet, was 3 feet up among small and closely growing birch trees about a spring about 20 yards up the slope from the margin of the valley floor. The 3 eggs were about $\frac{1}{2}$ incubated.

On June 17 a nesting pair of fox sparrows was found in a half-acre, dense growth of birches near Kingston Creek, 7200 feet. The female flushed from the nest at the base and on the north side of a clump of birches. The nest was settled down among the sprouts, but its rim was at least 25 cm. above ground. Dead leaves over the top completely concealed it. All the ground immediately surrounding the site was wet and seepy. Two freshly laid eggs were found in the nest and another, fully formed but without a shell, in the oviduct of the female. Three residual follicles, of 3 sizes, could

be seen plainly in the ovary. Evidently these diminish rapidly in size after the ovum is expelled.

The next day, June 18, a nest was found near Kingston Creek at about 7000 feet. This one was 120 cm. up to rim in a tangle of birch, willow and rose, and covered with a vine of another kind. The nest was compact and was supported by upright stems of a tall shrub. It was not well hidden as the stems were free of twigs and foliage at that level. Inside diameter of the nest at its rim was 6.5 cm.; outside diameter, 12 cm. In the nest there were 2 downy young, 1 or 2 days old, and an addled egg. My attention was directed to the vicinity first by the excited chirping of the male. Search then revealed the nest with the female brooding the young. The female stayed on the nest until I stood within 3 feet of it. After 30 seconds she flew off and joined her mate in hopping from twig to twig in the close vicinity and uttering nervous calls. The male sang 2 or 3 times from a perch high in a birch tree. The young seemed to be helpless, and they made no move or sound.

On a tributary of Kingston Creek, at 8700 feet, Miller found a nest on June 13, 1930. It was on a nearly horizontal limb of a birch growing on a steep bank so that the nest was about 6 feet above the ground. The branches and twigs were so dense about the nest that it was barely visible from above. The nest itself was made chiefly of birch bark and contained some grass in the lining. A few birch twigs surrounded the solid, firm birch bark cup. The brooding female was flushed by striking the nest from below. Upon leaving the nest she made no sound, but perched quietly on a twig over the wet ground 15 feet away. Examination of the bird showed that the brood patch was well developed. Although incubation of the 3 eggs had progressed not more than one-third, no ovum in the ovary was larger than 1 mm. in diameter.

Along North Twin River, on June 21, 1933, a nest was found within 20 feet of the stream at 7800 feet. It was 5 feet above the ground in the dead, lower branches of a large willow clump. Surrounding the site which was in a rather dense tangle were willows and tall aspens. The nest was made of dead sticks, shreds of bark, and leaves, the bark being most prominent. It was lined with such material as fine grass stems and horsehair. Inside measurement at the rim was 55 mm.; outside, 120 mm. Adults were near, and they showed much excitement. Two eggs were contained in the nest.

On the same day at a little above 8000 feet on North Twin River a nest was found 1 foot above the ground in a rose bush. It was resting on dead branches at the southern edge of a patch of tall vegetation on the floor of the valley, 30 feet from the creek, and surrounded by willows and rose. It was in a situation fairly well shaded. Shreds of bark constituted the chief materials in the nest, and the lining was of some fine, grayish material. The rim inside measured 60 mm. No adult was on the nest when it was discovered, but soon one came and uttered a few notes of alarm as it hopped over the surrounding ground. Contents were 3 eggs.

Passerella melodia fallax (Baird)

Song sparrows in Smoky Valley inhabited the brushy thickets close to springs and pools. Usually, but not always, open water made up a part of

the habitat. Because the total area of this kind was small, the population of song sparrows was comparatively small. In the mountains this species found suitable habitats along the streams at the mouths of cañons and on the meadows at middle altitudes. Birch Creek and Kingston Creek provided the most extensive habitable areas and supported the greatest populations of all the streams studied. These song sparrow habitats were clustered about 3 levels; 5500 feet, the lowest part of the region; 6500 feet, the approximate mean of the cañon mouths; 7500 feet, an average for meadows in the whole mountain range.

A casual inspection of song sparrow surroundings at these 3 levels might result in the notion that the bird lives in 3 widely different kinds of surroundings, for the altitudinal range is 2000 feet or more, and there are marked contrasts in the topography. Besides this the vegetation shows considerable diversity both in species and in general appearance. The kinds of plants most often utilized by song sparrows are willow, rose, buffalo berry, currant, cat-tail, wild rye, and aspen. The two first named were common to all 3 inhabited levels. When the birds are watched closely, it becomes apparent that they have selected 1 type of habitat which recurs at 3 contour levels, but which, as far as the birds are concerned, is remarkably uniform. Storms occur more frequently in the mountains, the nights may be colder, and, possibly for these reasons, the birds seem to be less numerous in proportion to the available area there than in the lower valley.

Foraging song sparrows were most often seen singly. They were quiet and made little commotion. The actual foraging ground was usually in low, dense growths of plants. For example 1 bird was watched as it foraged over the ground and on low twigs and sticks close to the base of a large willow clump at the margin of a meadow. Such places not only supplied more easily obtained food stocks than drier, more open ones, but they provided better screen for escape from danger. That is, they more nearly resemble the kind of living place to which the song sparrow has become adjusted over its whole range. They were better for this kind of bird, not necessarily for small birds in general. Once, on May 20, 1933, a song sparrow was seen catching insects in flight over water of a pond.

Singing birds nearly always perched in or near the tops of bushes or low trees. One bird, on May 21, 1932, sang 21 times from 1 perch in the top of a currant bush before it flew away (Orr). Songs were heard all through the day but more often in early morning. On June 10, 1930, Miller heard song sparrows sing at dusk in willow thickets near Kingston R. S., 7500 feet. That evening he heard one sing after dark, at about 10 p.m. That observer was unable to detect any constant difference in rhythm or pitch of the songs of these sparrows compared with residents of the same species (but different race) at Berkeley, California. In the Toyabe birds, however, quality was slightly more metallic—there was more of a "burr" in all notes of the song, suggesting some of the quality of the Lincoln sparrow's song. On several occasions series of harsh notes were heard which sounded exactly like the alarm notes of a chickadee. The observer was almost sure that a chickadee made the sounds until the song sparrow was actually seen making them.

In 1932, a song sparrow was noted, at 3 p.m. on May 25, singing in rose bushes near a small cattail marsh 5 mi. SE Millett. On the 28th it was watched again. The wind was strong so the bird kept down within the protection of the brush and sang from a perch that was well out of sight. It seemed neither to take notice of the red-winged blackbirds or marsh hawks nesting near it, nor to be noticed by either of those species. The nest was found at this site on June 7. It was on the ground at the south base of a rose bush. Two adults were near by but the nest was empty. The next day 1 parent and a fully feathered young one were seen on the ground only 2 feet from this nest.

Another nest, found on May 29, was in a clump of wild rye growing in a small rose bush at the side of an old path and surrounded by a dense thicket of rose, willow, buffalo berry, and wild rye. The nest was 8 inches above the base of the clump. It was built mainly of grass stems and was completely hidden in every direction but north where it was only partly screened. In it were 4 young, nearly grown and with feathers ready to break out of their sheaths. While I was near the nest, a parent came within 10 feet and continually uttered fine chirps. It was joined by a fox sparrow. A song sparrow sang 50 feet away. Later a parent carrying food was chased away from a dead willow by a yellow warbler which uttered harsh notes during the pursuit. The young were out of this nest on June 7.

On May 27, 1933, a nest was found 1 foot above the ground in a broken down tangle of a dead rose bush interspersed with dead grass and small willow shrubs. This was on the margin of a large thicket, 5 mi. SE Millett. A brooding adult flew off directly, with 1 or 2 alarm notes, when I walked within 3 feet of the nest. Another individual sang several times from a perch about 30 feet away. The nest contained 4 eggs. Two days later the nest was empty but otherwise undisturbed. On the northeast side of it was a trail of dead grass stems that had been dropped during construction and which made a trail about a foot long.

On June 3, another nest was found $\frac{1}{4}$ mile from the one mentioned above. Its rim too was a foot above the ground. The nest was in a clump of wild rye, flattened out and growing at the base of a scraggly buffalo-berry bush. It rested on a stem of the latter shrub but was partly supported and mainly screened by the grass. A pathway, like the one described above, led away from it toward the southeast. The sites of the 2 nests were almost alike, and they were similar to hundreds of other clumps in an area where not more than 10 pairs of the species had been detected. The grass was mainly the growth of a previous season. A large buffalo-berry bush shaded the nest on the east. There were several clumps of rose and buffalo berry growing close on the east and south. On the north were clumps of wild rye and willow and on the west scattered small clumps of willow. The site was 40 feet east from the margin of a grassy marsh. Attention was directed to the nest by excited chirps of the 2 parent birds which fluttered over the ground close to it. Two kinds of notes were heard from the adults: a fine, high-pitched chirp and the ordinary, harsh alarm note. The 1 young bird in the nest was nearly ready

to leave. Possibly others had jumped out when I approached, for there was a fecal sac on the edge of the nest.

A pair was seen June 10, 1933, at a nearby dry marsh in the same vicinity. They were carrying food to young near the base of a willow, but I was unable to find a nest. The birds ranged more than 100 yards away and moved from bush to bush the whole length of the marsh.

In the mountains a nest was found by Lamb on June 23, 1930, near Birch Creek, 7000 feet. It was 2 feet up among the tangled, slender upright trunks of small willows at the edge of the creek. Young birds in the nest jumped out when they were disturbed, and all but one escaped. This one, a male, weighed 18.2 gm. They were unable to fly.

Mammals

Sorex vagrans Baird

The type specimen of a race of this shrew came from the Toyabe region, on the Reese River at about 6000 feet, at the line between Lander and Nye counties. A specimen has been reported from Cloverdale. Miss Kellogg trapped 2 males of this shrew at 6890 feet on Reese River on June 2 and 3, 1925.

In 1930, 8 specimens were obtained on the eastern side of the Toyabe Mountains. Two males were trapped, April 23 and 24, by Lamb close to a spring in Smoky Valley, 5 mi. SE Millett. One was at the side of a small hummock and the other under the edge of the brush fence placed there to keep cattle out of the spring.

Of 3 shrews from near Wisconsin Creek, May 26 and 30, 1930, two were trapped beneath willows among wet leaves at the edge of a spring where there was a tangle of rose and other bushes, and one was taken at the edge of the stream.

At the meadow near Kingston R. S., 7500 feet, a male and 2 females were trapped. The male was caught, June 6, 1930, in a trap set on dry leaves under a clump of willows in a meadow about 20 yards from the creek. On June 14, a female containing 5 embryos, each 5 mm. long, was trapped on leaves beneath a willow clump 10 feet from the creek. Another female was caught the following day among willows on the muddy bank at the edge of the water.

Weights of 5 males, two in April, two in May, and one in June were 5.5, 6.3, 3.7, 4.2, and 4.5 gm. A female in May weighed 3.9 grams; one in June with 5 embryos weighed 6.6 gm.

Sorex palustris Richardson

Navigator shrews were trapped on both Birch and Kingston creeks in the Toyabe Mountains. On June 13, 1930, a male, weight 10.4 gm., was caught along Kingston Creek, 7500 feet, under a small green bush about 8 feet from the creek and the same distance from a small patch of sedges (Lamb). On June 16, on the same stream at 7000 feet a male and female were trapped within 20 feet of each other on the low mossy bank of the stream. The stream at this point was 6 feet wide. The traps were set at what appeared to be landing places, that is at points where the bank was low and the water

edded against the spot. The stream had a few dead twigs and limbs in it here, but the flow was rapid (Miller).

At Birch Creek, 7000 feet, 5 specimens were obtained in 1930, by Lamb. A male, weight 11.3 gm., was caught on June 21, on dry leaves at the base of a clump of willows 4 feet from the creek. Two females were trapped on June 23. One, weight 14.3 gm., contained 4 embryos each 15 mm. long. It was taken at the edge of the water in the meadow. The other, weight 10.7 gm., was on the bare bank of the creek 10 feet from the water. Another female, weight 11.1 gm., was trapped on June 24, at the edge of the stream. A male, weight 16.3 gm., trapped on June 25, was also at the edge of the stream.

Myotis volans (H. Allen)

Seven specimens of long-legged bat were shot as the animals flew near the ground in early evening. Of these, 2 males came from near Kingston R. S., 7500 feet, June 13 and 15, 1930. A female and 2 males were obtained, June 16 and 17 along Kingston Creek, 7000 feet. Two females came from Birch Creek, 7000 feet, on June 20 and 21. The first of these contained a single embryo 8 mm. long.

Myotis evotis (H. Allen)

Two big-eared bats were obtained, June 11 and 12, 1930, from the attic of Kingston R. S. One was a male, weight 7.2 gm., the other, a female, weighed 6.3 gm. (Lamb).

Eptesicus fuscus (Beauvois)

The single specimen of brown bat from the Toyabe Mountains was a male, weight 13 gm., shot June 21, 1930, near Birch Creek, 7000 feet.

Mustela cicognanii Bonaparte

A specimen of this small weasel (no. 208919, U.S.N.M.) was obtained on August 17, 1915, from South Twin River, in the Toyabe Mountains by L. J. Goldman.

Mustela arizonensis (Mearns)

On May 31, 1932, at 10:15 a.m. a long-tailed weasel was seen at a spring by remains of old ranch buildings 6 mi. SE Millett, in Smoky Valley. At first it was on the ground beneath some willows, and then it ran to an overturned shed. Next it was seen in brush pile on the opposite side of a small stream. A readily available food supply in this vicinity was present in the large population of pocket gophers on adjacent pasture land.

Spilogale gracilis Merriam

In early September 1931, a dead spotted skunk was found in a garbage container at the Forest Service camp ground on Kingston Creek, 7000 feet. It could not be determined whether the animal had been killed and thrown there or had crawled into the can after food and then found itself unable to escape.

Taxidea taxus (Schreber)

Two freshly trapped badgers were obtained on January 12 and 13, 1927,

by Miss Alexander from the neighborhood of Millett, in Smoky Valley. On April 23, 1930, a bleached skull of a badger was seen among the sand dunes 4 mi. SE Millett.

On June 26, 1930, near Birch Creek, 7000 feet, a large number of badger holes was found, some of them freshly dug, which indicated that several individuals inhabited this vicinity and that they fed extensively on the ground squirrels (*Citellus oregonus*).

Specimens of badger were obtained, December 6 and 10, 1926, by Miss Alexander at the Gondolfo Ranch, 10 mi. W Austin, in the Reese River Valley.

A trapper of long experience in this region, Mr. Otto Daniels, told me on June 11, 1930, that badgers were found wherever food was available on the mountains or in the valleys. He had found only 1 individual to a den, but several times had trapped two together in 1 trap set.

Urocyon cinereoargenteus (Schreber)

Presence of the gray fox in Smoky Valley was established by Miss Alexander and Miss Kellogg who on December 28, 1926, obtained one that had been trapped by an Indian near Millett.

Canis lestes Merriam

Twelve specimens of coyote from the Toyabe region represent localities as follows. Gondolfo Ranch, 10 mi. W Austin in Reese River Valley; 15 mi. E Austin; Millett; Milman Ranch, 19 mi. SE Millett; Darrough's Hot Springs. We saw and heard coyotes at many localities throughout the area but especially in the lower part of the mountains and in Smoky Valley. On one occasion one was started up from its daytime resting place in tall grass on the floor of Smoky Valley.

Mr. W. A. Smithline who lived at the mouth of Kingston Creek told me of a female trapped in April 1930 in Smoky Valley which gave birth to 10 young. He said that dens could be found by following the creeks across the flats. There the animals dug into the low banks. In his experience the coyotes in summer moved high into the mountains where there was then good foraging. He said that in 1929 he lost approximately 150 lambs on the spring sheep range. Soon after that the range was poisoned. The following year his loss to coyotes was 4 lambs.

Another man in this neighborhood Mr. Otto Daniels had had considerable experience in trapping coyotes. He said that these animals moved all over the mountain range and the valleys. He said that in this locality young coyotes are born in March and April and that litters number from 5 to 11, averaging 8 or 9. Best time for hunting dens he thought was May. Then the young leave many tracks as they come and go in the vicinity of the den. He thought they ordinarily lived there for about 2 months.

Felis oregonensis Rafinesque

Former occurrence of mountain lions in the Toyabe Mountains was reported by several resident persons. On June 11, 1930, Mr. Albert Daniels

told me that he used to find tracks of one near his place on the meadow on Kingston Creek, 7300 feet, but that 8 or 9 years earlier an Indian had trapped one near the mouth of the cañon, and since then no track had been seen. He had no definite knowledge of any others in the area. Mr. W. A. Smithline knew of the trapping of this individual and pointed out to me where it was caught, over a hill to the southwest of his house near the mouth of the cañon. Mr. Otto Daniels told me that the mountain lion was common in the Toquima Mountains and the next range to the east of them, but that any in the Toyabes were stragglers.

Lynx rufus (Schreber)

Five specimens of wildcat were obtained in December 1926, by Miss Alexander and Miss Kellogg from Indian trappers at Millett. On June 20, 1930, a skeleton of a wildcat that had been skinned was seen by a fence corner at a roadside 1 mi. below the house at the mouth of Kingston Creek. Ranger A. R. Torgerson told me that one had been trapped, before 1930, in a birch clump just below Kingston R. S. Mr. Otto Daniels told me in 1930 that this species was common all over the Toyabe Range in summer, that it followed the streams and lived permanently among the rocks, and that it was kept trapped down by the Indians.

My only glimpse of a wildcat in the area was of one seen at 6 a.m. on June 28, 1931, close to the creek at the deserted house on Birch Creek Meadow. The cat walked up the slope to the southward, moving slowly and stopping at frequent intervals to look about. Ten minutes later it was seen to go behind some large rocks at the top of the ridge. The animal, a large one, apparently did not detect the presence of persons, for it walked nearly the whole distance and seemed to be in no particular hurry. It did not go in a straight line, but angled up the hill to the right and then to the left. When first seen it was distant not more than 150 yards. Flickers by their notes of alarm were the only birds to indicate that they knew of the presence of the wildcat.

Marmota flaviventris (Audubon and Bachman)

Marmots were found at several places, mostly at high altitudes, in the Toyabe Mountains. On May 21, 1930, 3 marmots were seen on tops of rocky points of outcrops from 8800 to 9000 feet on the ridge south of Wisconsin Creek. Each one slipped quietly out of sight when I was still 200 yards off. Accumulations of droppings showed these animals to be regular inhabitants of these rocky places. On this date the air was cold, but the rocks were warm. On May 25, fresh droppings and recently thrown out trash were found at a small rock outcrop at 8500 feet on the same ridge.

On an east-facing slope near the south fork of Mohawk Creek at 9700 feet a marmot was seen on June 19, 1931. When first seen, the animal was only 15 feet away from me. It quietly and quickly slipped out of sight among the rocks.

Otospermophilus grammurus (Say)

Persons living along Kingston Creek pointed out to us a place along the lower course of that stream where they had seen rock squirrels. We obtained no specimens, but in early September 1931, I saw one in this vicinity. The squirrel was sitting on a brushpile in the sunshine close to the bank of the stream. As soon as it saw me it turned and made for cover beneath the brushpile.

Callospermophilus lateralis (Say)

Nineteen specimens of golden-mantled ground squirrel were preserved from the Toyabe Mountains. These represent localities from 7000 to 11,000 feet in the valleys of Kingston and Wisconsin creeks. Seasonally these specimens were all taken between May 23 and June 19, 1930. One was seen in the fall, on September 6, 1931, at 8000 feet in Mahogany Cañon.

Observations made upon a few individuals at each of our camps in the mountains help to show the range of habitat occupied by this animal. Near Wisconsin Creek, 8800 feet, on May 21, 1930, 3 individuals were seen on top of large rocks at various outcrops. Each one whistled when approached, but ran off when I came within 100 yards of it. A female was caught each day of May 23, 24, and 25, within a small area less than 50 yards across, near Wisconsin Creek, 7800 feet. One was beneath a piñon, one at the entrance to a mine, and a third among piñons at the edge of the cañon floor. On May 27 a male was trapped on a rock by the remains of an old wood rat's nest at the base of a cliff in this same vicinity.

Near Kingston R. S. on June 4, 1930, a female was shot at 6 a.m. at the entrance to a burrow beneath the base of a mountain mahogany on the margin of a clump of trees and on an east-facing slope. At 8 a.m. on June 4, a male was shot from a rock on top of a ridge at 9300 feet. Another female was trapped on June 7, in this vicinity, at the entrance to a burrow beneath sage brush on an alluvial cone and 75 yards west of Kingston Creek. At 10 a.m. on June 9, a female was shot at the entrance to a den among rocks in a low pile in the shade of mountain mahogany at the margin of a sage-covered opening in Mahogany Cañon, 8000 feet. Other shrubs near were *Symphoricarpos*, *Prunus*, and *Ribes*. The stomach of this animal was filled with green vegetable material. The squirrel made no sounds when discovered. The condition of its 5 pairs of teats indicated that the breeding season was long past. Three others seen this day on the rocky cañon floor among mountain mahoganies and sage brush, 8000 to 8300 feet, ran to rocks for safety.

At 7:30 a.m., June 11, 1930, one was seen on top of a dead stump of limber pine on the north-facing slope of Mahogany Cañon. Here, at 9000 feet, the slope was steep and rocky and there were a few small limber pines as well as stumps and sage brush. The squirrel seen was out in the sunshine. It uttered single notes of alarm and also a trill or chatter of 10 to 15 notes given with emphasis on the first ones and with increasing speed toward the end of each series.

After a rain on June 19, 1930, a golden-mantled ground squirrel was seen in a small heap of rocks beside the road at 7000 feet in Kingston Cañon.

When approached it ran off rapidly to more secure cover. On May 23, 1932, about 4 individuals were seen on rocks and running to rocks for shelter near 7000 feet in Last Chance Cañon.

On June 21, 1930, near Birch Creek a squirrel was seen in upright, picket-pin position on a rock close to the stream. In a side cañon a young one of size of an average chipmunk was seen on that date. It was the smallest young one seen that season. Early in the morning of June 22, one was seen on top of a point of rock $\frac{1}{4}$ the way up on a large rock outcrop. On June 23 one was seen on a log close to a spring at the margin of aspens on a southwest facing slope at 8000 feet. Another that was disturbed on June 25 ran from shaded ground beneath birches close to the stream out to open, rocky ground where sage was growing. All the items given above appear to contribute to a final definition of the habitat and the important factors determining presence of this species.

Six males collected in the month beginning May 23, 1930, ranged in weight from 134 to 171.5 gm., average 152.5 gm. Two others, obviously young of the year weighed 104.4 and 114.5 gm. Ten females obtained at the same time weighed between 140 and 211.7 gm., averaging 169.9 gm.

Citellus oregonus (Merriam)

Specimens of Oregon ground squirrel were obtained by Miss Kellogg on June 1, 1925, at Bell's Ranch, 6890 feet, on the Reese River. From Kingston Creek, 7500 feet, 9 were preserved June 3 to 8, 1930, and 2 more were obtained on June 22, 1930, at Birch Creek 7000 feet. In addition 2 or 3 individuals were seen on the morning of May 13, 1932, and on other dates, along the road which crosses the mountains east of Austin. Near Mohawk R. S., on June 21, 1931, this squirrel was frequent, but not abundant, in grassy places along the stream. Individuals were not often seen but several were heard whistling as we walked along the stream. One was shot as it stood on top of a stone wall. All the colonies were definitely within the mountains.

Between June 3 and 15, 1930, observations were made on the large colony of squirrels on the meadow just above Kingston R. S. My estimate was that there were 500 ground squirrels around the margin of this one small meadow which was about $\frac{1}{4}$ mile long. The burrows extended in a belt about 25 yards wide, from the edge of the standing water upslope into the sage. Thus they were mostly in the grassy belt where the water did not come too close to the surface.

The young squirrels were out when we arrived and of sizes which weighed from 72 to 96.5 gm. (4 specimens). An adult male at the same time weighed 333.8 gm. Four adult females weighed 277.5, 290, 307.5, and 384.5 gm. Two adult males at Birch Creek weighed 343 and 355.5 gm. Mammas numbered 10 and, at least in some females, all appeared to be functional. No embryos were found in the females examined.

During the first half of June each family still occupied a single burrow system. However toward the end of that time several holes were seen with fresh earth at their entrances. These were mainly at the bases of sage bushes up to 100 yards from the wet part of the meadow, mainly on the floors

of side cañons. In the main cañon the squirrels were found as high as 8400 feet, wherever there were grassy places close to the creek. Downward they occurred at least through the Daniels Meadow.

The adults and young came out in the morning as soon as, but not before, the sunshine struck the ground where they lived. They were most active in the morning but were heard and seen throughout the day. The young ones were considerably tamer than the adults. The usual loud, rapid trill was given often as an alarm note, but not by all the animals within sight. One or 2 gave the whistle while the others watched silently or ran for cover. Several were seen up in sage bushes.

Each one examined had stomach and the rest of the digestive tract filled with green plant material. Where the squirrels were numerous around the edge of the meadow, they seemed to keep the plants down nearly to the ground. Some freshly cut stems were found lying in burrow entrances. Dandelion heads were seen that had been cut to pieces and the cottony parts discarded.

Burrows were either in the open or beneath sage bushes. Some had mounds more than a yard across, others had no earth outside and evidently had been opened from below. The diameter varied from small holes just large enough for young ones to get through, up to ones 10 or 15 cm. in diameter, possibly depending on the length of time they had been in use.

Mr. Albert Daniels was accustomed to keeping the numbers of squirrels down, on his hay meadow, by poisoning the animals. He told us that the squirrels were introduced into this valley about 60 years before that time by Indians who brought them from Birch Creek in order to insure a convenient food supply for the Indians. This tradition may have some significance in explaining the present discontinuous distribution of such animals as this species.

On June 23, 1930, this ground squirrel was found abundantly about the meadow on Birch Creek and up the side streams where there was some grass and herbaceous vegetation. There were some even out in the sage, but these were mostly young ones. Either the young ones were so nearly grown as to be hard to distinguish from adults in the field, or not many were out at this time. The former was probably the condition. Possibly the young were born earlier here than at Kingston Creek. The numbers at Birch Creek were too small to keep down the grass and other plants.

Citellus mollis (Kennicott)

The soft-haired ground squirrel was found at several localities in Smoky Valley and at one place in Reese River Valley. Miss Kellogg, on June 3, 1924, captured a young female near Bell's Ranch on Reese River. A male was preserved from Smoky Valley, 5 mi. SE Millett, on May 19, 1930, and one was taken, June 17, near the mouth of Kingston Cañon, 6000 feet, by Miller. The one from near Millett was one of 4 young ones trapped that day at the base of one bush on sandy ground. It weighed 32 gm. There were 4 or 5 burrow openings beneath this bush, with paths connecting them. Twice, squirrels around this bush were heard giving single-syllabled weak

whistles. Again, on May 17, 1932, 2 young individuals about 6 inches long were seen in this vicinity. Both ran down burrows. Young individuals were noted close to Twin River, 6000 feet, on May 27, 1932, and June 2, 1933. On May 21, 1932, many young ones were whistling from burrow entrances on gravelly, south sloping ground close to Peavine Creek about $\frac{1}{2}$ mile above Seyler's Ranch. Apparently the species was much more common in this locality than elsewhere in the region.

On June 3, 1930, 2 ground squirrels of this species were seen running for burrows beneath bushes about 15 mi. N Millett. This was on a well-drained slope. On June 10, about 50 were seen on high ground below the ranch at the mouth of Kingston Creek. Again on June 20, many were seen on dry, rocky ground about the margins of fields in this vicinity. Their burrows were open with small mounds, sometimes beneath bushes and sometimes where there was no cover. The squirrels seemed to be concentrated where green food was available. On June 26, several burrow systems were noted with large mounds.

Ammospermophilus leucurus (Merriam)

Antelope ground squirrels were observed in small numbers at a few localities in Smoky Valley. Most of the individuals noted were on the desert, 5 mi. SE Millett. On May 13, 1930, 2 males were caught among bushes on sandy ground here. One was caught in the morning at the entrance of a freshly dug burrow. The other was trapped in the afternoon. They weighed 107.7 and 120.9 gm. Another individual was heard but not seen, May 17, in this vicinity. Several burrows were found that appeared to be occupied by this squirrel. On May 18, at the entrance of a burrow in a sandy mound a female was trapped, which contained 9 embryos each 11 mm. in long diameter.

In 1933 an antelope ground squirrel was seen on May 28 and 29 close to the deserted house 5 mi. SE Millett. In midafternoon of June 10 a $\frac{3}{4}$ grown individual was seen here, and again at noon on June 12 one was discovered inside the house. It ran down a hole at the edge of the floor. Late in the morning of May 31, 1933, a squirrel was seen close to this house clinging to the topmost branch of a 10-foot buffalo-berry bush. When approached within 35 feet it ran down through the bush to the ground and disappeared in some near-by brush (Compton). Another one that was seen on June 26, 1930, sought shelter among some fairly large rocks at the side of a road.

On June 1, 1933, 5 young antelope ground squirrels were seen on the desert close to the mouth of South Twin River cañon. They were playing and feeding about the entrance to a burrow, mostly within 5 feet of it and never more than 12 feet away. During the 10 minutes they were watched, the young animals investigated the tips of lower branches of bushes but did not appear to eat anything from them.

Eutamias minimus (Bachman)

The sagebrush chipmunk was the most numerous and most widespread member of its genus in the Toyabe area. It was present from the lower

valleys, 5500 feet, to the tops of the highest brush-covered ridges in the mountains. Specimens were obtained up to 8400 feet, but the species doubtless occurred higher than that. Forty-five specimens were obtained from the following localities: Smoky Valley, 5 mi. SE Millett (15); South Twin River, 6500 feet (1); Ophir Creek, 6500 feet (2); Wisconsin Creek, 7600 feet to 8400 feet (20); Kingston R. S., 7500 feet (6); Birch Creek, 7000 feet (2).

In Smoky Valley where this chipmunk was numerous, it was found most often up in the tops of these bushes, 8 or 10 feet above the ground. When approached, they would run to the ground and disappear. They were, as a rule, so wild that it was infrequent that one was seen clearly and closely enough to be shot. Some of the bushes had stems in their upper parts where the bark had been chewed off, apparently by this chipmunk. These toothmarks, together with the presence of so many of the animals noted up in the branches, suggested that this may be an important source of food for the species. Other individuals in this vicinity were obtained among clumps of rabbit brush and among sage bushes, sometimes in nearly pure stands of that shrub.

On May 14, 2 females were trapped beneath sage bushes on sandy ground. One of these was young of the year in light coat; the other an adult with milk in its mammary glands and evidently still suckling a brood of young. This one had seeds in its cheek pouches. Burrows opened close to where each was caught, which looked like old kangaroo rat dens, possibly then used by the chipmunks.

Late in the morning of May 16, a partly cloudy day, a chipmunk came hopping over wet alkali ground to the base of a currant bush 8 feet from where I was stationed. The bush was broken so that it was barely 3 feet in height. The chipmunk had a compact bundle ($\frac{1}{2}$ by 1 inch) crosswise in its mouth. The bundle was composed of grayish plant fibers and stems and evidently was intended for nesting material. Once while I watched, the loose ends were tucked into the mouth with the front feet. For about 3 minutes the animal moved about the base of the bush from 1 side to the other, usually screened from me, and watched me constantly. Meanwhile, it gave a single weak bark at intervals of 10 to 30 seconds. Each one was accented by a tail movement. Once for a short time ($\frac{1}{2}$ minute) the animal perched on a horizontal stem 3 inches above the ground, balanced on its hind feet with the front legs held against the chest. Finally after one trip behind the bush, it appeared without the load of material, and then after a short pause hurried in the opposite direction 15 yards to another larger bush of *Ribes*. Here it climbed to a stem 3 feet up and proceeded to utter a rapid series of scolding notes, meanwhile watching me intently. These notes were shorter and higher pitched than the first ones, and they came at a rate about as fast as I could count. About every 7 or 8 notes the tail was jerked forward 2 or 3 times. I walked to the bush and found the packet of grass stems where the chipmunk had dropped it. Apparently my presence had prevented the animal from completing the trip to its nest.

Elsewhere in the area, especially in the mountains this species usually was

associated with nearly pure stands of sage brush. Type of soil or nature of the slope seemed to have little to do with the presence of the animal. Nor did it require tall plants. Many places where it occurred were covered only with low sage bushes. Even where trees were available, this species seemed to prefer to live among the bushes. Its activity was not restricted, for it was often seen up in the bushes, as was noted previously.

At 11 a.m. on June 9, 1930, a female (no embryos) was shot as it carried a bundle of nest material over rocky ground in Mahogany Cañon, 8000 feet. It was among sage, *Symphoricarpos* and mountain mahogany and had green vegetable matter in its stomach.

One peculiarity in occurrence was noted in trapping these animals. In late April and early May, 1930, males collected greatly outnumbered the females. Later the same season, in the second half of May, the relative numbers were reversed and females outnumbered the males almost ten to one. Practically all these females had functioning milk glands, and evidently they had young in nests in late May. Possibly the females at this season had to forage farther and more actively than did the males. Also at that time they may have occupied different areas, but this seems less likely. The adults continued to be wary, and many more individuals were trapped than were seen alive. There was some difficulty in distinguishing this species from the Inyo chipmunk where they overlapped in ranges.

Records of weight of specimens taken in the 2-month period beginning April 21 showed the males to weigh on the average less than the females and also to be more uniform in weight. This is partly a reflection of differing response to the breeding season. Nineteen males ranged from 29.0 to 38.5 gm., average 42.2 gm. Most of the females at this time were suckling young.

Eutamias quadrivittatus (Say)

The Inyo chipmunk, in the Toyabe region, was an inhabitant of the higher parts of the mountains upward from 7000 feet. The habitat preference of this species, contrasted with *Eutamias minimus*, was for the neighborhood of rock outcrops, piles of sticks and brush, and similar places where refuge was provided. Sometimes these places were surrounded by sage, but the animal was not found in pure sage. It appeared to be considerably less wary than the sage brush chipmunk.

In the vicinity of Kingston R. S., 7500 feet, on June 4, 1930, 1 individual was shot as it clung to a branch of dead mountain mahogany and another as it clung to the top of a rock outcrop. On June 5, a male was obtained on the ground close to a fallen, dead mountain mahogany on an east-facing slope. On June 13, several were seen among mahoganies at 9000 feet. Two or 3 were seen in trees close to 10 feet above the ground. Another ran up into a leaning, dead tree. All the individuals observed appeared tamer than chipmunks had previously that season, but this may have been on account of the large proportion of young out at this time. One young one ran to another individual and seemed to attempt to suckle. Probably it was just then being weaned. On June 14, several chipmunks were seen and heard within the area of limber pines at 10,000 feet on the slope south of Kingston Creek.

Other types of situation where this species was captured varied somewhat as follows: among rocks and piñons; among rocks and brush; in hole high on rock outcrop; beneath sage bush; at entrance to mine tunnel; on floor in corner of a cabin. All the 15 specimens came from Wisconsin Creek and Kingston Creek.

Eleven out of the 15 specimens preserved were females. Two of these contained embryos: 1 on May 25 had 5, each 18 mm. long, the other on June 4 had 7, each 15 mm. long.

Weights of the four males were 54.0, 56.3, 60.5, and 62.5 gm. Weights of 10 females were 41.8, 52.2, 61.5, 65.8, 70.8, 73.2, 74.5 (emb.), 77.7 (embs.), and 85.5 gm.

Eutamias dorsalis (Baird)

We found the cliff chipmunk to be infrequent on the lower slopes of the Toyabe Mountains, between 6500 and 8000 feet, where it tended to occupy favorable sites in colonies. One such colony, observed, May 2 to 8, 1930, near South Twin River, occupied a rocky draw close to the trail to Arc Dome and over the second ridge from the base of the trail. Here there were a few trees and several old logs, mainly of piñon and juniper, and some brush piles on the ground. The first individual was seen 3 times on May 2. It was always running, and was so wild it would not permit close enough approach to be shot. On the morning of May 6 another was seen running over logs in this vicinity. At noon on this day the sun was shining. I was walking along a trail when I by chance caught sight of a chipmunk 10 feet above the ground, on top of a boulder pile on a south-facing slope. The chipmunk made no sound, and it did not move, thus permitting me to approach closely enough to shoot it. This was a female.

On May 7, 2 males of this species were trapped beneath dead piñon logs on this north-facing slope, near 7000 feet. On the same day a male was trapped beneath a wild plum thicket at the bottom of the cañon near the stream at 6500 feet. Tracks of one were seen in the snow on a log even below this. One of the individuals captured had a piñon nut in its cheek pouch. On May 8, a female (no embryos) was trapped beneath a piñon log on the same slope as the ones caught the previous day. To have escaped notice so well, these animals seemed to be especially quiet, or wild, for chipmunks.

On May 22, 1930, a young male (weight 32.3 gm.) was trapped beneath a sagebush on a rocky south-facing slope near Wisconsin Creek, 7800 feet. Another one (wt. 35.9 gm.) was caught, June 1, beneath a sage bush at 7600 feet at the side of the road near Wisconsin Creek. On May 31, a cañon which branches off to the north from Wisconsin Creek, 7000 feet, was examined by Lamb. It was quite thickly covered on its steep slopes with old piñon pines. On its eastern slope a rock slide extended halfway up the ridge from the bottom of the cañon. In this slide many individuals of the cliff chipmunk were active; at least 20 were seen. Several could be heard barking at once. Three females and 1 male were obtained for specimens. The next day a visit was made to this place, but later in the morning, and only 2 indi-

viduals were seen. Five were seen near here on June 2, 1932. On top of a ridge at 8000 feet, in this vicinity a young one watched on June 2, 1932, was eating grass. Later it was seen carrying a bundle of material which looked like sage bark.

In the cañon of Kingston Creek a single individual of this chipmunk was seen on a rock slide on the morning of June 16, 1930. On June 18, two were seen on rock slides on the cañon wall. On June 18, 1931, one was seen running over rocks among piñons on the north side of a ridge near Mohawk Creek. A half-grown individual was noted, May 23, 1932, among rocks in the gorge of Last Chance Creek, 6500 feet.

Weights of 4 males, in May were 49.1, 51.0, 53.7, and 55.5 gm., average 52.3; of 6 females, 41.6, 55.7, 62.0, 64.8, 67.0, and 68.7 gm., average 59.9.

Thomomys perpallidus Merriam

Pocket gophers were especially numerous in the large meadow in Smoky Valley, 5 mi. SE Millett. Much activity was noted here in late April and early May, 1930. Fresh workings were seen almost daily. There were no bushes on this ground and it was nearly bare, but there were many roots of plants whose leaves had not yet come above the ground. A female trapped here on April 26, contained 3 embryos each 30 mm. long. A male trapped on April 28 was thickly covered with fleas.

On May 14, 1930, an open hole was seen in this vicinity from which a gopher had been coming to the surface getting leaves of iris, cutting them into sections about an inch long, and taking them down the burrow. Besides the cut stalks, several sections lay just outside the entrance and a few were seen down inside the burrow.

On May 15, a hole that had been open at 7 p.m. the previous night was plugged and had a small mound at 6:30 a.m. Out in the meadow, on May 19, 1932, a mound was seen that was at least 7 feet long and over 3 feet wide. The earth had been freshly thrown out. All the mounds here were large, but this was the biggest one seen in the region.

During the 3 days before May 19, 1932, while flood waters from South Twin River were running across this meadow, many gopher burrows were filled with water and the occupants forced from them. At noon on May 19, 2 live gophers and 3 dead ones were noted on small islands out in this flooded meadow. One of the live ones remained quiet, and when disturbed, it finally withdrew into a small part of the tunnel that was still above the water level. The other one was pugnacious and it bit at the end of a gun barrel that was placed near it. When pushed off its mound into the water, it immediately swam back to it. Apparently it was characteristic for these gophers to stick to their homes even after being forced to the surface rather than to start out in search of more suitable home sites. And they remained despite an almost certain fate of being chilled to death or of being picked up by some one of the numerous predators which soon discovered this easily accessible food source and congregated there to take advantage of it.

On a slope at 7000 feet near South Twin River which was steep and west-facing, about 40 gopher mounds were counted on May 9, 1930. At 2 of

them dirt had been thrown out that day. All the others had been smoothed down by rain. In every case the earth had fallen down hill from the entrance, and the top of the mound, level with the entrance, was nearly flat. All burrows that I opened were close to the surface; it was less than 5 cm. down to the top of the tunnel. On the slope were noted a few scattered small piñons, many sage bushes, and a few bushes of other kinds. One bush was seen that was dead and had fallen over. Each of its rootstalks, more than 100, had been cut by a gopher. Some of the scars were old but most of the cutting had been done the previous winter.

One mound of a shape similar to the others was conspicuously different from them in color being brighter yellow. It was composed almost entirely of droppings and finely chewed refuse material. Evidently an underground nest had been cleaned and the trash thus disposed of.

Thomomys quadratus Merriam

Specimens of this pocket gopher were obtained, May 27 and 29, 1930, near Wisconsin Creek, 8500 feet, and June 4 and 8, near Kingston R. S., 7500 feet. Sixteen specimens were obtained in December, 1926, by Miss Alexander and Miss Kellogg at Birch Creek Ranch.

At Wisconsin Creek, about May 20, 1930, many mounds and winter earth cores of this species were seen both in the creek valley and on the higher ridges. They extended from 7000 to 9500 feet. In many places holes had been left open, probably where the animals had entered the ground beneath the snow. A few sets of fresh workings were seen, mainly around 9000 feet, although one was noted at 7000 feet. Most of the evidence of presence was on tops of ridges and close to the creek above 8000 feet.

On June 3, 1930, in the evening a gopher was seen pushing earth from a hole 6 feet from the creek at the meadow by Kingston R. S., 7500 feet. The soil was black and moist. A female was caught a few minutes after a trap was set. A week later a young one was trapped at this site, probably one of a brood left by the female. In this neighborhood the greatest amount of workings was in a higher meadow where the sod was heavy and the soil was only slightly moist.

A female trapped, May 27, 1930, in a grove of aspens at 8500 feet near Wisconsin Creek, contained 4 embryos each 13 mm. long.

Perognathus longimembris (Coues)

This pocket mouse was trapped in small numbers in the desert of Smoky Valley, south of Millett. On April 28, 1930, one was caught in a line of 100 traps set among sage and other bushes on sandy ground, 5 mi. SE Millett. On May 20, at 5 mi. S Millett, 6 individuals were caught in about 125 traps set over a slope of coarse gravel where bushes were scattered and mostly under 1 foot in height. Here there was an abundance of plants in flower compared with other parts of the valley. One small young individual was taken and a female that had suckled young recently. In the cheek pouches of one were small, dark, round seeds. In a line of 130 traps set on

the sandy ground 2 mi. S Millett, 5 young ones were trapped on June 2, and 2 adults and 3 young ones on June 3.

Perognathus parvus (Peale)

Fifty specimens of the Great Basin pocket mouse were obtained from the following localities. Smoky Valley, 5 mi. SE Millett (1); South Twin River, 6500 feet (10); Ophir Creek, 6500 feet (2); Wisconsin Creek, 7600 to 8500 feet (31); Kingston R. S., 7500 feet (5); Birch Creek, 7000 feet (1). These places ranged from near the center of Smoky Valley up the mountains to at least 8500 feet.

Places of capture of these animals indicate nature of the habitat as follows: E Millett in Smoky Valley a male was trapped close to a clump of rabbit brush on alkali soil. Close to South Twin River, 6500 feet, several individuals were trapped on a small flat, at the base of the mountains, covered with sage brush on a soil of coarse gravel. At Wisconsin Creek, 7800 feet, on May 21, 4 pocket mice were caught in 25 traps set among sage bushes along the north edge of the valley floor, where the soil was filled with small, broken rocks. One was trapped close to an old log cabin. A fifth one was caught among tall sage bushes close to the creek. Others were taken in similar situations. On May 25 a male was trapped at the edge of a clump of sage, rose and willow 2 feet high by 4 feet across on damp, gravelly ground at the upper margin of a large rose thicket on a seep at 8100 feet. Another male, 25 feet from this one, was beneath the edge of a sage bush on drier ground. Another one was in a runway beneath sage bushes 2 feet high on a rocky and gravelly, northeast-facing steep slope 50 yards from a grove of aspens. The soil was moist and fine grass covered about 1/5 of the ground between the bushes. On May 26, in this vicinity, 3 pocket mice were caught in *Microtus* runways beneath sage bushes on a rocky slope.

Additional individuals were taken on May 27, near this stream beneath a piñon among sage bushes, beneath a rose bush, beneath a sage bush at the edge of a rose thicket, at base of rocky cliff near sage brush. Cheek pouches of one caught among sage bushes contained seeds of rose and some pieces of freshly cut green leaves. Pouches of another one held sections of a green, grass-like plant. A male was trapped on May 28 beneath a rose thicket at the streamside where *Zapus*, *Reithrodontomys* and *Peromyscus* had been caught in the same trap. Another was on wet ground at the edge of the stream and below a slope covered with sage and rose. Near Ophir Creek, 6500 feet, 2 pocket mice were trapped on a rocky, east-facing hillside. On June 5, 1930, 2 were trapped beside small sage bushes on the valley floor close to the edge of the meadow at Kingston R. S. One was at the entrance to a *Citellus* burrow. An adult female was caught at the entrance to a hole beneath sage bushes on an alluvial cone west of this meadow. On June 25, near Birch Creek, 7000 feet, a female suckling young was trapped along a fence between clumps of wild rye around the meadow and sage on a slope.

Embryos recorded in females of the Great Basin pocket mouse in the Toyabe area were as follows.

Date	Number embryos	Altitude
May 1, 1930	4	6500 feet
May 5, 1930	6	6500 feet
May 5, 1930	6	6500 feet
May 5, 1930	7	6500 feet
May 6, 1930	5	6500 feet
June 10, 1930	6	7500 feet

Weights of the 10 heaviest females (without embryos) ranged from 19 to 28.5 gm., average 22.6. Weights of the 10 heaviest males ranged from 25.5 to 30 gm., average 27.0.

Dipodomys ordii Woodhouse

In Smoky Valley, 5 mi. SE Millett, 5 specimens of this kangaroo rat were caught in late April, 1930. Another one was caught on June 2, 2 mi. S Millett.

A female trapped on April 21, was at the entrance of a burrow 8 by 4 cm. in diameter on a flat, open meadow where green plants barely showed above the ground, and the whitish soil appeared bare. One bush 20 yards from the site was the only plant of any size in the vicinity. There were several other holes of differing sizes near by. The occupied one showed no trace of a mound. The opening may have caved in. Another individual trapped at the entrance of a burrow 10 yards away had been eaten by some animal so that only parts of the hind legs and tail remained. The trap had been dragged part way down the hole. The female preserved weighed 48 gm. and contained 3 small embryos. Its cheek pouches were filled with small, thick leaves from a plant that, in the surrounding area, barely showed above ground.

Weights of 2 males in April and one in June were 54.6, 45.7 and 43.9 gm. Two females weighed 40.0 and 47.1 gm.

Dipodomys microps (Merriam)

Forty-three specimens of this kangaroo rat were obtained in the Toyabe area in Smoky Valley from near its center at 5500 feet up to its western edge at the base of the mountains at 6500 feet.

In Smoky Valley, 5 mi. SE Millett, on April 22, 1930, a male and female were caught in 37 traps set among sage bushes. The female contained 2 embryos each 13 mm. in length. Her cheek pouches were filled with pieces of dried leaves of several kinds.

This species was found in larger numbers near South Twin River, 6500 feet, than in any other locality where traps were set. On April 29, 4 individuals were caught in 90 traps set on a small sage-covered flat there. One had green seed heads of alfalfa in its cheek-pouches. All the burrows seemed to be left open during the day. At each den there was a small mound with from 3 to 8 openings, usually with 2 or 3 showing evidence of recent use. Seven individuals were trapped at dens on May 2. Two were caught at the same mound. There were 5 females, 1 with no embryos, 2 with 2, 1 with 3, and 1 with 3 scars indicating young already born. On this date 1 or 2 bur-

rows were seen which were filled with dirt at their entrances, but most of them were open. At each mound 1 or 2 holes showed a little freshly scratched out earth. On May 5, 2 kangaroo rats were taken out of 88 traps at 8 p.m., just as it started to snow. None got into the traps after that time.

In this vicinity on May 6, 1930, an adult female containing 2 15-mm. embryos was caught at an entrance to a burrow in a mound. At another opening in the same mound was trapped a half grown young one and 15 feet away another of the same size. This indicated that the young stay with their mother in the home burrow at least up to this size and that they forage by themselves. Also that in this region the female brings forth consecutive litters, sometimes with a short interval between them. Another female trapped on May 9, contained 2 embryos (18 mm. long) and its nipples showed evidence of recent suckling. Hairs were short around the mammae in the inguinal region. It was caught in a beaten pathway beneath and through a low sage bush. One trapped on May 11, contained a single embryo 37 mm. long.

On May 20, on the desert 5 mi. S Millett, 2 females were trapped, 1 with 4 10-mm. embryos; the other, a small one had green leaves and seed pods of some kind of mustard in its cheek pouches. Mounds and burrows, some of them closed, were frequent in the gravelly ground where the bushes were low and where flowering plants were then abundantly in bloom. On June 2, a trap line on the sandy ground, 2 mi. S Millett, caught 2 females each containing 2 embryos.

Microdipodops megacephalus Merriam

On April 24, 1930, 2 females (no embryos) of the kangaroo mouse were trapped (1 preserved) in the sand dunes, 4 mi. SE Millett in Smoky Valley. One hundred traps had been set, but rain interfered with the catch. The following night 6 individuals were caught in 166 traps set among the same dunes. There were 4 males and 2 females, 1 with 4 embryos each 4 mm. in diameter. No other kind of mouse except *Peromyscus* was caught. Weights of the 4 males were 11.0, 13.0, 14.5, and 14.5 gm. The 3 females mentioned above weighed 10.7 (emb.), 13.5 and 16.0 gm. On May 13 another female, weight 14.9 gm., was caught on a sandy mound in this vicinity.

Onychomys leucogaster (Wied)

This grasshopper mouse was found in the Toyabe area in small numbers from the lowest point up at least to 7500 feet in the mountains. In the Reese River Valley, a female was trapped on December 2, 1926, at the Malloy Ranch, 5 mi. W Austin, by Miss Alexander and Miss Kellogg. A female was trapped, June 21, 1930, by Miller near Birch Creek, 7000 feet. This one was on a moderately steep hillside where there was no grass on the hard-packed coarse gravel, and the sage bushes were barely a foot high.

Near Kingston R. S., 7500 feet, a female was trapped, on June 11, 1930, beneath the edge of a small rock on an alluvial cone at the margin of the creek valley. The uterus was enlarged but embryos were not distinguishable. The site was surrounded with sage bushes. Weight was 28 gm.

Specimens from Smoky Valley come from 5 mi. SE Millett, September 13, 1931, 11½ mi. NE San Antonio, 5700 feet, September 16, 1931, and San Antonio, 5400 feet, September 17, 1931.

Reithrodontomys megalotis (Baird)

Seventeen specimens of harvest mouse were taken in the Toyabe area at various localities in Smoky Valley and in the mountains up to 7800 feet, as follows: Smoky Valley, 5 mi. SE Millett (7); South Twin River, 6500 feet (5); Ophir Creek, 6500 feet (2); Wisconsin Creek, 7800 feet (3).

In Smoky Valley, SE Millett, on April 21, 1930, a female was trapped at the base of a clump of rabbit brush in a nearly pure stand of that plant. The bush was 3 feet high and 5 feet in diameter. The ground was mostly bare with some dead grass, averaging 5 cm. in height. Some dead stems around the base of the bush provided cover. A female on April 26, was trapped at the edge of a large clump of rose in a tract of buffalo berry. Another was at the base of a clump of rabbit brush. At that locality no individual was caught in a grassy situation; all were in brush.

Near South Twin River, 6500 feet, on May 1, 1930, a male was trapped beneath a sage bush on a gravel flat. On May 9, one was trapped in a pathway beneath a rose thicket next to the stream and close to where *Microtus* were caught. Another was beneath a clump of sage 75 feet from the stream where the sage was close together and where there was some gravel in the soil. A female, containing 4 8-mm. embryos, was beneath a small piñon among sage bushes 15 feet from the stream. On the following day a male was caught at this spot. At this locality also this mouse was found among fairly thick bushes but not in grassy situations.

A female trapped on May 18, 1930, near Ophir Creek, 6500 feet, contained 4 13-mm. embryos.

Near Wisconsin Creek, 7800 feet, 3 males were trapped. One on May 21, 1930, was caught in sage at the edge of a rose thicket by a spring. On May 27, one was trapped at the margin of a wild peach thicket close to the creek in the same place that a jumping mouse had been trapped on the previous day. On May 29, one was caught beneath a sage bush at the side of the road close to the stream.

Eleven males, trapped in April and May, ranged in weight from 9.6 to 14.0 gm., average 11.7.

Peromyscus maniculatus (Wagner)

As we had anticipated, this white-footed mouse proved to be the most widely distributed kind of mammal in the Toyabe area. It was found everywhere that we trapped, and in most types of habitat it proved to be the most numerous kind of mammal. Any sort of protection whether provided by bushes, logs, trees, rocks, wood rat nests, burrows of other small mammals, or burrows dug by white-footed mice themselves seemed to provide the necessary essentials of hiding places required. This species occurred even in the habitats where the closely related cañon mouse was common.

Some trapping records for *Peromyscus maniculatus* in the Toyabe region.

Locality	Date	Altitude	No. traps	No. specimens
Smoky Valley	April 22, 1930	5500 feet	37	4
Smoky Valley	April 25, 1930	5500 feet	166	3
Smoky Valley	April 26, 1930	5500 feet	75	2
South Twin R.	April 29, 1930	6500 feet	90	20
South Twin R.	May 1, 1930	6500 feet	90	17
South Twin R.	May 2, 1930	6500 feet	44	17
South Twin R.	May 3, 1930	6500 feet	100	26
South Twin R.	May 4, 1930	6500 feet	100	17
South Twin R.	May 5, 1930	6500 feet	88	18
South Twin R.	May 6, 1930	6500 feet	88	15
Smoky Valley	May 14, 1930	5500 feet	50	3
Ophir Creek	May 18, 1930	6500 feet	164	53
Smoky Valley	June 3, 1930	5500 feet	130	6
Kingston Creek	June 10, 1930	7500 feet	25	8
Birch Creek	June 21, 1930	7000 feet	35	6
Birch Creek	June 24, 1930	7000 feet	100	10

The above-cited records of trap lines were selected at random from a large number. They are sufficient to show that this is an abundant mammal in the region and also that in the early summer of 1930 it was most numerous along the base of the mountains—compared with higher parts of the mountains and the lower part of Smoky Valley. I suspect that this distribution of numbers was characteristic for other seasons also.

The 3-month period beginning April 20, 1930, when most of our observations upon this mammal were made, corresponded with the main period of reproductive activity of this mouse. Of 49 females recorded containing embryos, 1 had 1; 1,2; 7,3; 16,4; 14,5; 8,6; 2,7. The modal number was 4, the average nearly 4.5.

Peromyscus crinitus (Merriam)

Specimens of the cañon mouse were trapped at 3 localities along the eastern base of the Toyabe Mountains. At South Twin River, 6500 feet and 7000 feet, 13 were taken, May 3 to 9, 1930. One was trapped on May 18, at Ophir Creek, 6500 feet. Six were trapped, June 16 to 19 along Kingston Creek, near 7000 feet.

This species contrasted markedly with its near relative (*Peromyscus maniculatus*) in being restricted to a narrow range of habitat conditions. In the vicinity of South Twin River this mouse was caught only on the cañon wall. At every place where one was caught, rocks were present within a few steps, and usually the whole substratum was rock. Numbers were slightly greater than for *P. maniculatus* in this habitat, but much smaller (in ratio of 1 to 5) than for *maniculatus* in favorable places in the sage. One was caught on May 8 beneath a piñon log at 7000 feet at least 20 feet from the nearest sizable rock. The next day in the same vicinity 2 were caught beneath logs within 10 feet of rock piles.

Females trapped on May 5, 6 and 9, contained 4 embryos each.

Neotoma lepida Thomas

Thirty specimens of the desert wood rat were trapped in the Toyabe region, at the following localities: Smoky Valley, 5 mi. SE Millett (1); South

Twin River, 6500 feet (21); Ophir Creek, 6500 (7); Wisconsin Creek, 7800 feet (1). We found the species, then, from the center of Smoky Valley up nearly to 8000 feet in the mountains, but most numerous along the cañons at the base of the mountains.

In the vicinity of South Twin River many accumulations of sticks, small rocks and trash, gathered by this wood rat were found along the cliffs and beneath scattered small boulders. Most of them appeared to be old. Each mass of material appeared to be much smaller than is usual with the larger kinds of wood rat. Below the mouth of the cañon 1 or 2 nests were seen at the bases of bushes along the stream bed where there were many scattered small boulders. On May 5, 1930, 3 wood rats were caught in 19 traps set from the bottom to the top of the north side of the cañon. In many places here stems of *Ephedra* had been cut into sections and piled on the ground, usually in the center of some bush or beneath a rock. The rats seemed to be more frequent beneath isolated boulders than on large rock slides. On May 7, a male was caught at a nest in a small pile of stones at the base of a post surrounded by sage brush on gravelly ground. On June 18, 1933, a young wood rat, half-grown, was frightened from an old nest of sage thrasher in a wild peach thicket close to the stream bed, a mile below the mouth of the cañon.

On May 22, 1930, near Wisconsin Creek, 7800 feet, a wood rat was trapped at a nest in a big rock outcrop on a slope north of the stream. No others were caught in this vicinity although traps were set at many places. Nests were frequent about the rock outcrops and cliffs and some of them appeared to have been occupied recently. White-footed mice (*P. maniculatus*) were caught at nearly every nest.

Our experience here tended to bear out what we had been told by a miner who lived in the neighborhood up to about 1928. He had found wood rats abundantly along the base of the mountains; they occupied every mine shaft and all the cabins, but they suddenly disappeared, and for a time he found great numbers of dead ones "killed by disease" at about the time many of the jack rabbits died. I saw a few parts of skeletons. A large proportion of our specimens were young ones.

A female caught on May 2, 1930, and another on May 6, contained 3 small embryos. A female trapped on May 10, had been nursing recently as was shown by its enlarged milk glands and mammae and by the shortness of the hairs in the inguinal region. In addition it contained 3 embryos each 12 mm. in longest diameter. On May 8, 9, and 10, 4 young wood rats about 1/3 grown were caught close to one nest. Nearly every wood rat caught away from a nest was a young one; evidently they leave their homes and wander at an early age.

Neotoma cinerea (Ord)

Seven specimens of bushy-tailed wood rat were preserved from Kingston Creek, 7000 to 7500 feet. On June 17, 1930, one was seen near the end of an old mine tunnel, on a ledge about 200 yards back from the entrance. On June 18, two were trapped. Among the rocks and near some old houses large

stick nests were built, but back in the mine tunnels the nests were small open cups, 20 to 30 cm. across and constructed of finely shredded bark which appeared to be from sage bushes. This leads to the suggestion that a major purpose of the stick nests may be to make a dark hiding place for the smaller nest.

On June 22, 1930, much evidence of wood rats was seen about the large rock outcrops above the meadow on Birch Creek. Late in the morning one was seen on a projecting shelf in a dark pocket in a cavern beneath one of these outcrops. Deposits of excreta on these rocks, especially where shaded, were black. These showed up conspicuously beneath much-used perches on points of rocks. Parts of nests showed at many of the crevices and pockets over the face of the cliff.

Microtus montanus (Peale)

Twenty of the 24 specimens of this meadow mouse taken by us in the Toyabe region were obtained in Smoky Valley, 5 and 6 mi. SE Millett. Three were taken in the meadow above Kingston R. S., 7500 feet, and one near Birch Creek, 7000 feet.

This meadow mouse was most numerous in Smoky Valley in marshy spots about the springs and pools. On April 21, 1930, many recently made holes and runways were seen, some of them containing fresh cuttings of grass stems. All of the recent workings seemed to be directly over, or close to, water. Some were in hummocks of sod surrounded by water. Another much used place was beneath thickets of bushes at the water's edge. Apparently the low grass available then did not furnish sufficient cover for protection of the animals. The places that had recently dried seemed to have been deserted. No long surface runways were seen.

On May 16, 1932, many recently occupied burrows were noted at the margins of ponds in this neighborhood. At one place there were 2 mounds which apparently contained material that had been carried out of a tunnel system by a meadow mouse. The material seemed to be largely the remains of food stores, sections of stems and tubers, although part of it evidently was soil. From each mound a definite path led to fresh surface tunnels.

Two females trapped on April 25, 1930, contained 5 and 6 embryos, each about 20 mm. long.

Microtus mordax (Merriam)

Microtus mordax was found at our trapping stations in the Toyabe Mountains as follows. South Twin River, 6500 and 7000 feet (8); Ophir Creek, 6500 feet (1); Wisconsin Creek, 7800 to 8500 feet (17); Kingston Creek, 7500 feet (6); Birch Creek, 7000 feet (4). These specimens and other evidence of the presence of this animal showed its presence from a little below the base of the mountains up to the highest brush-covered ridges—ranging in altitude from a little over 6000 feet to over 10,000 feet.

Near the mouth of South Twin River home sites of this animal were found on the rocky cañon walls, among or close to rocks and bushes. At one place, on May 6, 1930, there were stems of freshly cut green grass, but at no

place was there much evidence of plainly marked runways. On May 9, a large adult male and 2 juveniles were trapped in runways beneath sage bushes close to the stream at 6300 feet. The next day another adult male and 2 young ones were caught in the same runways. The ground here was dry, and the runways were not deep or roofed. The situation was much like the one where *Lagurus* had been trapped, half a mile away but was nearer to water. Many fresh cuttings of a kind of lupine were found beneath the bushes. Some pieces had not been moved but had been left where cut.

This kind of meadow mouse was found in late May, 1930, on a north-facing slope south of Wisconsin Creek and between 8500 and 8700 feet. Other kinds of mice trapped here, in the order of their abundance, were *Peromyscus maniculatus*, *Perognathus parvus*, *Eutamias minimus*, and *Lagurus curtatus*. Mounds and droppings indicated that *Thomomys*, *Sylvilagus*, and *Erethizon* also lived there. The slope was just about as steep as the rocks and soil would lie. Bushes, mainly sage brush and *Symphoricarpos*, were under 3 feet in height. Compared with other slopes in the vicinity there was a considerable amount of herbaceous plants, but they were scattered. In this area, which was about $\frac{1}{4}$ mile square, nearly every bush had runways and holes of *Microtus* beneath it. Also at more than half of these bushes there were piles of bark shredded in small strips and small heaps of recently cut leaves. There were scattered pellets of excrement, some fresh but mostly dried. This slope had been covered with snow for most of the winter and, compared with others, late into the spring. A few small drifts remained at the upper edge of the area. Above the pure sage there were some scattered mountain mahoganies.

An explanation which seems probable for the relation of *Microtus* to this sort of habitat is as follows. In winter when the snow is deep here the *Microtus* burrows into it and lives on the bark and leaves of sage and whatever other plants are standing there. After the snow melts and while the ground remains moist, the animals live in burrows beneath the bushes and make paths, which are not roofed, among the bushes. The young wander to more favorable (more moist) places, downward along the streams and upward along the margin of the retreating snow. Thus the population dwindles until none is left when the ground becomes dry. The fall of snow the following winter starts this annual cycle over again.

On the south side of the cañon of the south fork of Wisconsin Creek at 8500 feet there was another slope almost identical with the one just described, and it too showed evidence of occupation by *Microtus* in large numbers. There were runways beneath the bushes and large amounts of freshly cut shreds of bark and tips of leafy stems. Three large adults were seen here late in the morning of May 29, 1930.

On June 14, 1930, on the ridge south of Kingston Creek, 9000 to 10,000 feet, there were found abundant workings thought to belong to this species, on the north-facing slope close to lingering snow banks or in places where snow had melted within a few days previously. The habitat appeared to be like that near Wisconsin Creek where these mice were trapped.

Embryos of this *Microtus* were recorded, in 1930, as shown in the following tabulation.

Date	Number of embryos	Length in mm.
May 24	6	4
May 25	3	13
May 27	6	17
June 11	6	13
June 23	5	15

Lagurus curtatus (Cope)

On May 2, 1930, close to North Twin River, 6500 feet, a female sagebrush vole was trapped beneath a clump of sage 2 feet high and 3 feet in diameter, at the edge of a small rocky draw. The ground was thickly covered with rocks. Directly beneath this bush there were 2 large rocks nearly 2 feet across. At their lower edges were burrow entrances. Indications of runways beneath the bush were present but faint. Piled in them, close to the main stem of the bush were bunches of freshly cut sage leaves and stems and a few pieces of herbaceous plants. The sage bushes in the vicinity averaged knee high and about 3 feet apart. The stones were close enough together to hide the ground. Stems of the sage brush showed that they had been chewed. A white-footed mouse was caught beneath the same bush. The sagebrush vole contained 6 small embryos.

The following day an immature female was trapped at the base of a rock among sage bushes higher up on the same slope. Many of the traps placed near here held white-footed mice.

Near Wisconsin Creek, 8500 feet, on May 26, 1930, an adult male weight 33.5 gm. was trapped in a runway beneath sage on a rocky gravelly slope, northeast facing and 100 yards up from a grove of aspens along the creek. The runway beneath the bush had many cut leaves of sage. Also the bark had been chewed off many of the upper stems. There were some small clumps of grass in the vicinity.

In the Reese River Valley, males of this mouse were trapped by Miss Kellogg on June 4, 1925, at Bell Ranch, 6890 feet, and October 22, 1925, at Dutch Flat School House, 6715 feet. Another one was taken, October 24, 1925 by Miss Alexander at the latter locality.

Ondatra zibethica (Linnaeus)

Seventeen muskrats were obtained in December, 1926, by Miss Alexander and Miss Kellogg, at the Gondolfo Ranch, on the Reese River, 10 mi. W Austin. On June 16, 1931, a muskrat was seen swimming in a pool in the Reese River just north of the Lincoln Highway. It was carrying a bunch of plant material. The animal dived and entered a hole in the bank beneath the surface of the water.

Otto and Albert Daniels told me on June 11, 1930, that there were many muskrats in Reese River Valley, and that someone in Smoky Valley had trapped some of these animals in winter and had turned loose several at some springs in Smoky Valley. They thought however that all these transferred animals had perished.

Zapus princeps Allen

Jumping mice were found on two streams on the east side of the Toyabe Mountains. Between May 24 and June 1, 10 males and 1 female were taken along Wisconsin Creek, 7600 to 8500 feet. June 5, 6, and 15, 1930, males were trapped near Kingston R. S., 7500 feet, and a female was taken on the latter date. This one contained 4 embryos each 4 mm. long.

Situations where jumping mice were caught were rather closely restricted to the streambanks or to seepy areas close to streams. At each place the ground was moist or wet, and nearly everywhere there was some grass or herbaceous vegetation or both beginning to show through the ground. Taller plants close to places of capture were rose, willow, wild peach, and sage. At least 1 individual was trapped where the stream was only a little over a foot wide. Every one caught was within 20 feet of water.

Eleven males in May and June weighed between 21.5 and 28.5 grams, average 26 gm. A female (no embryos) weighed 26.7 gm.

Erethizon epixanthum Brandt

Porcupines were found over all the Toyabe area wherever there were bushes or trees. Rather few individuals were actually seen in proportion to the amount of evidence noted of their presence. A summary of our observations upon this species is here given in chronological order.

On May 1 and 2, 1930, many trees whose bark had been gnawed by porcupines were seen on the slopes near South Twin River, 6500 feet. These gnawed areas were especially noticeable close to the bases of the trees. They were mostly piñons. At least 1 tree appeared to have been killed by porcupines. Near the lower end of Ophir Creek, on May 18, many piñons showed removal of bark by this animal. Some of them had been girdled completely and had died or were dying.

Near Wisconsin Creek, 7800 feet, many of the piñons showed where bark had been eaten. Two young trees less than 6 feet high, noted on May 21, 1930, close to the upper limit for the species were dying, evidently because they had been girdled by porcupines. Close watch in this vicinity revealed no other plants, bushes or trees, than piñon which showed evidence of being eaten by porcupines. Droppings were frequently seen scattered along the paths through sage brush on the valley floor as well as about the rocky outcrops which must have served as daytime retreats for porcupines. The small number actually seen in the daytime supported the belief that most of them sought such retreats. A female, weight 8 lb., was shot on May 27, 1930, among the branches of a mountain mahogany at 9000 feet near Wisconsin Creek.

At 9 a.m. on May 30, 1930, a porcupine was seen near Ophir Creek, 8100 feet, in a clump of thickly growing willows. It was on top of prostrate branches eating leaves and small stems. Finally it walked off slowly through the tangle.

A young porcupine (wt. estimated at 7 lb.) was seen climbing into a medium-sized mountain mahogany at 9000 feet on a ridge near Kingston R. S.

in the morning of June 6, 1930. Nearly every piñon noted in this neighborhood had large areas of bark chewed off, and bark on some of the mountain mahoganies had been eaten. Ranger Torgerson told us that at that season the porcupines were living almost entirely on herbaceous plants in the meadows. A dead porcupine was seen on June 12, at the base of a willow clump beside the creek at 8200 feet. A young one was seen resting on a horizontal limb of birch on a wet, southwest facing slope at 8700 feet. On June 13, at 9000 feet in a side cañon were seen mountain mahoganies and limber pines with large areas of bark removed by porcupines. Some of the former kind of tree were dying, apparently from effects of this damage. On a ridge to the south at 10,000 feet, many scars were found on limber pines on June 14. Also there were fresh feces which showed shreds of bark—some on top of snow directly beneath the pines. Mr. Albert Daniels told us that 125 porcupines had been killed in this vicinity the previous year. The excuse for killing this animal was its supposed interference with cattle in the mountains by eating forage in the meadows and as a source of injury if the cattle stuck their noses into the quills.

A large porcupine was seen early in the morning of June 21, 1931, at the edge of a meadow near Mohawk R. S. For several minutes it fed on the foliage of a rose bush, then when disturbed by persons coming near, it walked slowly up a rocky slope. At each step the footing was tested and often the foot was withdrawn and placed at some other spot. Most of the ridges in this vicinity showed where bark had been removed by a porcupine.

A porcupine that was startled from the ground among mountain mahoganies in Mahogany Cañon, on June 29, 1931, scrambled up a near-by, low bush. One that was seen at dusk on June 1, 1932, in the road just below the fork of Wisconsin Creek, ran out of the way of an approaching automobile.

In 1933, on May 30, at 6 a.m. a porcupine was seen in Smoky Valley, 5 mi. SE Millett. It was standing upright in a path between bushes, eating the bark from a stem of wild rose. In the evening of June 8, a partly grown individual was seen in the top of a willow tree near South Twin River. A dead one was seen, June 20, high on the divide between North Twin and South Twin rivers. Another dead one was seen, June 22, at the roadside, 10 mi. E Austin.

Ochotona schisticeps (Merriam)

On June 19, 1931, about 10 pikas were heard or seen and 2 females collected on rock slides from about 8500 feet to about 9700 feet on a ridge southwest of the right fork of Mohawk Creek. At 2 places, at least, there were accumulations of freshly cut green branches of bushes such as surrounded the rock slides. At 1 place were seen branches of *Artemisia*, *Chrysothamnus*, *Symphoricarpos*, *Ribes*, and a herbaceous plant. The piles were not just accidental leavings, but they were large accumulations of half a bushel or more of material. Most of it was the leafy foliage of bushes. No grass or sedge was available. Many of the individuals seen were young ones less than half grown. These seemed to be less timid than the old ones. The rocks on which these pikas lived were dark brown—almost exactly the shade of color

of the sides of the animals. This made it exceptionally hard to see them for even at a short distance; the animals blended into their surroundings almost perfectly. On June 20, pikas were heard in rocks near the divide at 10,000 feet.

Where the trail crosses the south fork of Wisconsin Creek, a pika was heard on June 4, 1932. In the morning its calls were given when a great horned owl flew over it. In the afternoon the animal ran to the rocks near here when I approached. It appeared to be an adult. It made no sound when I walked over the rocks. Evidently the rock slide had not been inhabited for long for the only evidence of past presence that I could see was a few cut twigs of piñon pine.

On several occasions in June, 1933, pikas were heard in rock slides along South Twin River and North Twin River. On June 13, one was heard in a rock slide near limber pines at 9000 feet close to Summit Cañon.

Lepus californicus Gray

Jack rabbits lived in the larger valleys of the Toyabe area and they lived commonly up to the very base of the mountains. Some individuals lived in the mountains, as along Mohawk Creek where half a dozen were found during the 5 days before June 21, 1931. Most of the observations on this animal, however, were made in Smoky Valley, 5 mi. SE Millet.

In that locality on April 20, 1930, about 25 rabbits were seen after 3 p.m. among the tall bushes. When the sun was warm in midafternoon several individuals were moving about, but they always went to the shade on the north side of a bush when stopping to rest. Early the next morning several individuals were noted as they fed. By 10 o'clock most of them had gone to forms within clumps of bushes. All were on the shaded side even though it was not a hot day. At 11 a.m. a young rabbit, only a few days old, scrambled out of the center of a small, dead clump of sage, as I approached. I was able to overtake and capture it within a few steps. It was noted in this vicinity that in the thicker stands of brush the rabbits showed less tendency to run than when approached in the open. In the brush they were likely to hop just out of sight and to move much less swiftly than on the flats. Two individuals were watched on May 19 among some bushes. One of these laid back its ears and made a dash at the other which then left that neighborhood.

An illustration of lack of training of the senses and the little development of fear in the young jack rabbits was noted on May 5, 1930, near South Twin River, 6500 feet. A young individual that I approached started from a form in the center of a sage bush. When I stopped, it froze—up on its toes—and after a minute or so it crawled back into the form. Another one, on May 9, moved ahead of me up a dry, rocky stream bed. It kept about 20 feet ahead of me, moving just enough to keep out of the way and stopping frequently. At this locality it was noticed that the adults were seen more often on the flat open ground while the young individuals were found close to the streams and farther toward the mountains.

Sylvilagus nuttallii (Bachman)

Five specimens of cottontail were obtained in December, 1926, in the vicinity of Austin by Miss Alexander and Miss Kellogg. They collected 4 more in January, 1927, in Smoky Valley, 5 mi. SE Millett. Two males from this locality were collected on April 22, 1930, and a female on April 25. From Wisconsin Creek, 7800 feet, a male was taken on May 21, 1930.

In Smoky Valley this rabbit was seen most often at the margins of small clearings on wet ground close to springs. Here tall thickets of dense bushes such as rose, currant, buffalo berry, rabbit brush, and willow provided safety refuge and the grasses, and herbaceous vegetation on the wet ground provided desirable food supply. One that was noticed on May 16, 1930, on wet, grassy ground, was hopping through wet grass. It made slow, deliberate leaps, seemingly in an effort to avoid wetting its fur. A female taken here on April 25, 1930, had functional milk glands.

In the mountains cottontails or evidence of their recent presence were noted along the streams and on the ridges at least to 9500 feet. The species was numerous on June 21, 1931, up to this altitude along Mohawk Creek. Many young ones only a few days old were seen in the thickets along the stream. On September 6, 1931, one was seen on rocky ground covered with mountain mahogany at 8500 feet on the southwest side of Bunker Hill. On May 23, 1930, a cottontail was seen among tall bushes close to Wisconsin Creek, 7800 feet. A young one jumped on the rocky north-facing mountain side, stopped 10 yards off, and then ran beneath a piñon and among some sage bushes.

On May 18, 1930, squeaking sounds such as usually attract small birds were being made in a small cañon near the mouth of Ophir Creek. In response to those squeaks a cottontail came toward me through the tall growth of sage, moving rapidly and appearing greatly concerned. Possibly this was a female whose young were concealed in the vicinity.

Sylvilagus idahoensis (Merriam)

A large series of specimens of pigmy rabbits was obtained in the winter of 1926-27, by Miss Alexander and Miss Kellogg from the Toyabe area. These were from 3 localities: Gondolfo Ranch, 10 mi. W Austin in Reese River Valley; Austin; vicinity of Millett, in Smoky Valley.

In Smoky Valley, 5 mi. SE Millett, many burrows and runways of this rabbit were seen in a belt of tall sage brush. The ground here was thickly covered with pellets. On May 13, 1930, a young one less than 3 inches long was seen among these sage bushes. When approached it dodged back and forth between the bushes for a time and then went down a burrow. On June 8, 1933, a young individual more than half grown was seen in tall sage bushes close to South Twin River a little more than a mile below the mouth of the cañon.

Odocoileus hemionus (Rafinesque)

The mule-deer was common over most of the Toyabe Mountains during the time of our work there. Ranger A. R. Torgerson told me in 1930 that he had estimated that there were 559 deer in his district, between Austin and Summit Creek, in 1929. On June 11, 1930, Otto and Albert Daniels told me that they believed the deer were increasing in the mountains. The latter had counted 56 deer in one day the previous fall in the upper part of Kingston Cañon. The increase was thought by them to be due to killing of coyotes which had killed fawns. They knew of several instances of fawns being killed by coyotes. They further reported that in the Toyabe Mountains there was usually only 1 fawn, and it was born about June 1. Although the deer usually stayed in the mountains they went down to the foothills in stormy weather and they were known to cross Smoky Valley.

Local miners in the North Twin River district appeared to use deer meat whenever opportunity came, regardless of the season. At least their conversation and equipment indicated such a custom. However, the large number of the animals and the small number of persons living in the mountains made this possible danger of small concern for the deer. Their greatest danger seemed to be more in the possibility of development of the area by building roads so as to make it too easily accessible for hunters from the outside.

Deer in the mountains were most often seen as they moved off after being disturbed by us. Favorite resting places were found to be in the thickets of mountain mahogany trees. On May 25, 1930, a bed was found that had been used by deer within a day or so. It was on bare ground beneath a mountain mahogany tree within a thick stand of that tree at 8500 feet on the south side of Wisconsin Creek. On June 6, a bedding place was seen on bare ground beneath a mountain mahogany at 9000 feet on an east-facing slope west of Kingston Creek.

Fawns were seen in this area on a few occasions. At 6:15 a.m. on June 14, 1930, a spotted fawn was seen with a doe close to the trail south of Kingston Creek at 8600 feet. On June 30, 1931, a female with a fawn was seen on a ridge north of Kingston Creek. On August 31, 1934, near Birch Creek, an adult female with 2 fawns and another grown one jumped from a thicket of aspens on a sidehill.

Single antlers of deer were picked up on May 29, 1930, near Wisconsin Creek, 8500 feet, and June 7, 1930, near Kingston R. S., 7500 feet.

Ovis canadensis Shaw

On June 8, 1933, a weathered horn of mountain sheep was found close to the trail up South Twin River at about 7500 feet. Many local resident persons in the region told us about occurrence of mountain sheep in the high, southern part of the Toyabe Mountains. One report was that some person shot a sheep in the fall of 1931, in South Twin Cañon, but that he was afraid to bring it out and left the carcass where he shot it. Another report was that a mountain sheep had joined a band of domestic sheep and had spent the winter at one of the ranches in Smoky Valley.

Summary

The Toyabe Mountains, a high mountain range in central Nevada, and the adjacent valleys contain habitats representative of much of the Great Basin. The efforts of 5 persons on 321 days in this area between 1930 and 1933 provided the chief basis for this report. In addition to field notes, photographs, and plant specimens, about 2500 specimens of vertebrates were preserved.

Emphasis in this report is given to the accounts of species and the responses of each kind of animal to its environment and especially to other animals. In all 215 kinds of vertebrates are listed and discussed, including 3 amphibians, 13 reptiles, 152 birds, and 47 mammals. Most attention was given to the birds.

Some characteristics of birds of the Great Basin that distinguish them from birds in other types of environment were revealed in this study. Among these the following seem sufficiently prominent to deserve emphasis and special study by anyone who has opportunity to work in this region.

Nests on or near the ground are necessitated by limitation of the plants to low strata.

Flight songs are noticeably frequent probably on account of scarcity of high perches.

Songs and calls are loud as must be the case if scattered members of a species are to hear one another.

Scattered distribution involves high development of vocal powers to compensate for the separation of individuals.

Resistance to wind is effected mainly by avoiding strong winds and by acquiring strong powers of flight.

Adult protective coloration is exemplified by a high proportion of the species and appears to be correlated with scarcity of plant cover.

Adaptive coloration in downy young, with respect to intensity of sunlight, is shown in striking degree.

High proportion is migratory, obviously on account of the severity of the winter climate. Many species which do not leave the region move to milder parts to escape storms.

Adaptive coloration of nest lining appears to parallel closely that of downy young.

Long range vision is acute, probably directly the result of scattering of individuals and lack of screen of plants.

Resistance to heat is effected mainly by avoiding it through perching in shade or off the ground.

Nests on southeast side of bushes were observed so frequently as to suggest some special significance in the circumstances. It may be connected with preference of building individuals to work in the sunshine in early morning when the air generally is cold. Or it may be partly the result of effort to escape strong wind by working in the lee of bushes.

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Notes on the Natural History of Some Marine Animals

G. E. MacGinitie

The observations on *Lamellaria stearnsii*, on the food habits of the northern octopus, and on mussel succession in northern waters were made at the Hopkins Marine Station, Pacific Grove, California. Observations on the remaining animals were made at the Kerckhoff Marine Laboratory, Corona Del Mar, California, or in the field in this vicinity.

Porifera

Although sponges have but few enemies, they are subject to the predacious activities of certain other animals, especially gastropods, of which the nudibranchs are the most important. *Lamellaria stearnsii* Dall, a yellowish gastropod with an internal shell, seems to feed almost exclusively upon sponges, mainly the yellow sponge *Lissodendoryx noxiosa* de Laubenfels. I have also seen the cushion star, *Patiria miniata* (Brandt), making a meal of this incrusting sponge.

Sponges usually remain fixed after the larvae become attached, but on the mud flats of estuaries of Southern California there is a sponge, *Tetilla mutabilis* de Laubenfels, which, when settling, fastens itself in the mud by a strong, slender stalk (Pl. 1, Fig. 2). This stalk, which is about two inches long, consists of a number of fine strands which are fringed at their lower ends so that they anchor the animal firmly. The sponge, which possesses but a single osculum when young, continues to grow until it reaches the size of a pigeon's egg or a little larger, whereupon it usually breaks loose from the stalk and is rolled about over the mud flats by the tides (Pl. 1, Fig. 3). It may move a considerable distance from the place where it settled, continuing to grow until it becomes an irregular mass, six inches or more in diameter, having several oscula. I have never observed this sponge burrowing by contraction as some other sponges do. On April 25, 1935, I found thousands of young *Tetilla*, ranging from one fourth inch to two inches in length, anchored in the mud near Harbor Island in Newport Bay.

Also, it is usually considered that sponges are not readily grown in the laboratory, but at the Kerckhoff Marine Laboratory larvae of *Sycon coronatum* (?) (Ellis and Solander) (Pl. 1, Fig. 1) often come in with the circulating water and become fixed in great numbers over the sides of the aquaria or upon solid objects in the aquaria, where, unless removed, they continue to develop until they reach a length of about three centimeters.

Coelenterata

The eolid nudibranch, *Antiopella aureocincta* MacFarland mss., eats the heads of the solitary hydroid, *Corymorpha palma* Torrey (Pl. 1, Fig. 7). The eolid also makes another use of the hydroid, for it deposits its eggs upon the

bases of the latter. The nudibranch is so nearly the color of the heads of this hydroid that only close scrutiny reveals the presence of the mollusc. In this region *Corymorpha* often occurs on the mud flats, about one to every four square inches, in areas many feet wide and fifty or a hundred feet long.

The larvae of the sea pansy, *Renilla köllikeri* Pfeffer, settle in the water at or below low tide mark, and many of them migrate to the portions of the flats exposed at low tides. This migration is accomplished slowly by changing position from day to day. The stem is withdrawn from the substratum and the colony moves a distance of a foot or two per day by a peristaltic movement which progresses throughout the entire colony. (Parker, 1920, worked out in detail the types of peristalsis and their direction of movement in *Renilla*.) At Anaheim Slough (17 miles north of here), on December 26, 1936, I found many young *Renilla*, measuring from 0.7 cm. to 5 cm., which had thus migrated to the exposed mud flats.

Stylatula gracilis (Gabb), a sea pen which is very common in the mud flats of Southern California, is easily reared in the laboratory. When the sea pens are brought in and allowed to lie in a dish of salt water, they will give off eggs and sperm if they are ripe. Eggs laid one day become planulae the following day, and three days later the larvae have settled to the bottom. By this time they possess tentacles and perform peristaltic movements along the body. If they are fed they will continue to grow, developing new heads every few days on alternate sides of the forming colony.

Echiuroidea

Spawning in Urechis.—Eggs and sperm of *Urechis caupo* Fisher and MacGinitie are stored in six segmental organs as they are produced, and spawning takes place during a short season, usually in the spring or at the beginning of summer as the temperature of the water rises. Since spawning is inhibited, at least for a time, by bringing the worms into the laboratory, it is thus possible to keep a supply of embryological material when the specimens in the field are spawned out (MacGinitie, 1935a). Worms are best kept in the laboratory by placing them in glass U-shaped tubes (MacGinitie, 1935b). One male *Urechis* which I have kept thus in the laboratory for a period of two or three years spawned on May 24th and 25th of this year, and I was fortunate enough to observe the process both times.

Just prior to spawning the *Urechis* came nearly to the opening of the burrow, whereupon three ridges were thrown around the body of the animal so that the creases were just anterior to each of the three pairs of gonopores, and the gonopores themselves were somewhat protruded and turned toward the anterior end of the body, and, therefore, toward the opening of the burrow. The openings of all six gonopores became quite conspicuous; this was followed by several retching movements, as though the animal were attempting to regurgitate, and then sperm issued in a stream from each gonopore. When the sperm ceased to be expelled, the animal underwent a violent peristalsis, the waves running from the posterior to the anterior end, causing the sperm to pour out of the tube. The retching, followed by the violent antiperistalsis,

was performed three distinct times. On both days after spawning the worm went back to the bottom of the tube, pumped vigorously for some time, and then resumed feeding. During spawning the body of the worm was much more elongated than normally. The spawning on May 24th took place at 4:30 p.m., that on the following day at 9:20 a.m. The storage organs were practically emptied the first day of spawning, but the movements and procedure on the second day were the same as for the first spawning, although very little sperm was discharged.

Annelida

On January 27, 1935, an examination of the faecal pellets of the tube-dwelling annelid, *Chaetopterus variopedatus* Renier et Claparède, showed that they contained larval pelecypods. When the pellets were broken apart with needles, these young clams, apparently larval Teredos, opened their valves, spread their veliger wings, and swam about actively, none the worse for their trip through the digestive tract of the worm. Larval clams which were embedded near the surface of the pellets were able to escape unaided within a few hours. Undisturbed pellets were placed in a dish and allowed to remain for four days until they began to disintegrate, whereupon the larval clams which were thus liberated from the central portions of the pellets, swam away. The pellets are cylindrical, with rounded ends, and average 5 mm. in length by 0.8 mm. in diameter.

Distribution of Estuarine Larvae

The preceding note concerning *Chaetopterus* brings up another subject which has been the cause of considerable discussion by biologists who are interested in the distribution of marine animals. Distribution of animals which live along the open beach is, of course, rather easily accounted for, but animals which are indigenous only to estuaries furnish a more complex problem.

To begin with, it should be kept in mind that the invasion of larvae of a certain species from another estuary, occurring once every thousand years, would be sufficient to maintain a constancy of specific characters. This is true mainly because of the comparatively static conditions of marine estuaries over long periods of time, with the resulting lack of stimulus to evolutionary change. This condition is also indicated by the fact that investigation of recent fossil remains show that these animals have changed but little over a period of several million years. Some of the forms found in marine estuaries have a rather long larval period, as for example, the echiuroid worm, *Urechis caupo*, which has a larval period of from 40 to 60 days (MacGinitie, 1935c). An animal which has a larval period as long as this could depend entirely upon currents for its distribution from estuary to estuary. In times past other forms could easily have been carried from place to place, say on the bodies of whales with their covering of barnacles. The females of the California gray whale made use of the estuaries along the coast of California and Lower California as a place of refuge when giving birth to their young. Today, with the great numbers of "foul bottom ships" passing along the coast of all

countries, a means of distribution is provided for practically all forms of larvae of estuarine animals. Since *Teredo* and other pelecypod larvae are able to withstand trips through the alimentary tracts of other animals, they may be thus conveyed long distances from their place of origin. *Chaetopterus variopedatus* is known to build its tube among the sessile animals which foul the bottoms of floats and boats which are left in this bay (Newport Bay, California) a year or more without cleaning. Because of the fact that *C. variopedatus* is a native of the Atlantic, and as late as 1922 (C. Berkeley) was not known to occur on this coast, it would not be surprising if this animal migrated to the Pacific Coast on the bottom of some ship. I found *C. variopedatus* at Newport Bay on January 20, 1929. Mr. S. A. Glassell, who recently has collected in the Gulf of Lower California, reports that this species occurs abundantly there.

Ophiuroidea

Estuarine and ocean bottom forms subsist mainly upon the organic materials contained in the detritus of the surface of the mud. Much of this organic material is bacteria (ZoBell and Anderson, 1936), and is contained in the top centimeter or so. Even though deeply buried, all detritus feeders that I have studied, except *Callianassa californiensis* Dana, obtain their food directly from the surface.

Amphiodia barbatæ (Lyman), a serpent star, lives in the sand or mud, buried to a depth of about three or four inches, and extends the tips of its arms to the surface to obtain its food. It, therefore, obtains its food in somewhat the same manner as does the clam, *Macoma nasuta* (Conrad) (MacGinitie, 1935b). This habit of living necessitates long arms; the disk of one of these serpent stars (Pl. 2, Fig. 4) measured only 0.65 cm. in diameter, whereas the arms measured 15 cm. in length.

Two other interesting ophiurans, *Amphiodia psara* Clark (1935) and *Ophiacantha eurythra* Clark (1935) possess the unusual ability for serpent star of being able to swim rather efficiently. The former swims by extending one arm ahead, trailing two behind it, and using the remaining two arms as wings (Pl. 2, Fig. 3). However, it possesses this ability to swim efficiently only when young and while the rays are short in relation to the size of the disk as compared with their length in more mature specimens (Pl. 2, Fig. 2). *Ophiacantha eurythra* swims by using four arms as two pairs of wings and trailing one arm behind (Pl. 2, Fig. 5). In this case also I think it can be said that the young specimens swim better than the older ones, but, because of the fact that this serpent star drops off the distal portion of its arms when disturbed by the handling necessary in dredging it, the arms become sufficiently short that any sized specimens I have so far found are always able to swim. This latter species also makes what may be termed hopping movements along the bottom of a dish in the laboratory, using the same motions that it does in swimming. Either species may swim for as long as two or three minutes at a time. *Ophiacantha eurythra* is more easily stimulated to perform swimming movements than is *Amphiodia psara*.

There is no tendency with either species to use the same arms for the

same function during different swimming excursions. That is, *Amphiodia psara* may extend any arm ahead, or *Ophiacantha eurythra* may trail any arm behind. The tendency is for the serpent stars to start in the opposite direction from that from which the stimulus is applied, and, therefore, I think it can be said that swimming is performed as an escape reaction.

Gastropoda

The tooth shell, *Dentalium neohexagonum* Pilsbry and Sharp, as dredged off Newport Beach, often has its ovaries nearly filled with cercariae. I do not know to what trematode these cercariae belong.

The large gastropod snail, *Bursa californica* (Hinds) Pl. 1, Fig. 4), nearly always uses one half of a large clam shell in which to deposit its egg cases. Occasionally other objects, such as a piece of rock, etc., may be used. The snail remains with its foot covering the circle of capsules until all the eggs are hatched. When removed from its "nest" this snail will hunt for the clam shell with its deposit of cases, and, upon finding it, will at once resume the brooding position; but as soon as the larvae escape from the cases the snail immediately leaves the shell and is no longer interested. The elongated capsules are laid on the inside of a clam shell, and are placed radially with their flat side toward the center, eventually forming a disk of capsules about two and one half inches in diameter (Pl. 1, Fig. 5). I have counted as many as 274 capsules in one group, and each capsule contains from 2500 to 3000 eggs. One snail spent five days laying its eggs, which began hatching twenty days later.

It is generally thought that the brooding habit or parental care is a great advantage in the rearing of young, and that, in general, the numbers of eggs laid by animals which show these traits are less, and, in some cases at least, the size of the egg, and, therefore, the amount of yolk is greater in those animals which brood their eggs. I doubt if this is true for marine gastropods in general. For example, there is another snail, *Kellettia kellettii* (Forbes), which does not brood its eggs, yet is more abundant than *Bursa*, though it is about the same size as the latter and lives under practically the same conditions. *Bursa* is somewhat more abundant in rocky regions than *Kellettia*, but both live at about the same depth and their food habits are much alike. I have counted the approximate numbers of eggs laid by both snails in what I judge to be average layings. *Bursa californica* laid 822,000 eggs, and *Kellettia kellettii* laid 196,000. Since *Bursa* broods its eggs and *Kellettia* does not, it seems that the reverse should be true.

I think that the comparison of these two snails bears out my contention that the greatest mortality occurs at the time of metamorphosis and establishment of the young in their permanent habitat and the activities which are typical of the adult animal. The two main factors which substantiate this hypothesis are: (a) metamorphosis may not take place in a suitable region for settling, and (b) the surface of the ocean bottom, whether rock, sand, or mud, is inhabited by a horde of predacious feeders which depend to a greater or less extent upon these settling larvae for their food. I am inclined to think that it is the ability of the *Kellettias* to get along better on the more open

ocean bottom that accounts for their being more numerous than *Bursa*. If this is true, it greatly extends, over that of *Bursa*, the region in which *Kellettia* may settle. Predacious feeders are more numerous in rocky regions, for most of them need refuges from their enemies, and, though certain predacious worms, crustaceans, and fishes bury in the surface of the mud, many more, in comparison, secure refuge among the seaweed and rock crevices of rocky shores.

So far as I am able to determine, the eggs of marine molluscs are not used by other animals for food, and so we are confronted with the apparent fact that the brooding habit of *Bursa* is of no advantage. If not, why did this habit evolve? So far as I have been able to observe, brooding serves two purposes among marine animals: first, to keep the eggs clean that gas exchange may take place (as in certain fishes, octopi, and crustacea), and, second, to shorten the free swimming larval period that settling may take place in a suitable location near adult colonies (as in *Ostrea lurida*, *Teredo*, *Aletes squamigerus*, and *Crepidula onyx*).

Pelecypoda

It is generally the case that when any species of pelecypod spawns, sperm and eggs are given off simultaneously by all the ripe members of the species of that particular region. The spawning of one stimulates spawning among the others. The larvae derived from such a spawning, though motile, are entirely at the mercy of the conditions of the water, that is, currents, tides, storms, etc. Perhaps it is the rule that whole spawnings are entirely lost, being carried to places in which there would be no opportunity for settling where conditions would be right for starting a new colony. The brood may remain fairly well concentrated or may become widely scattered, due to the factors mentioned above, and but few of the offspring find suitable places for establishment. Again it may happen that the fairly concentrated brood may be in a location where nearly all of the larvae which have survived the predacious attacks of other planktonic animals, will, upon metamorphosing and settling, find conditions optimum for the establishment of a rich colony. The segregation of the broods depends to a great extent on the length of the free-swimming stage, i.e., the shorter this stage the better the segregation at the time of settling, other things being equal. Therefore, aside from the numbers which are lost by falling prey to other plankton feeders, it depends upon the location of the brood at the time of metamorphosis or at the time of settling, whether any or most of them will survive. As one watches the tide flats from year to year, he often finds areas where a pelecypod of a certain species has settled in great numbers. Often these young clams will do well for a time, but, because of shifting sands, spring tides or other causes, they may be entirely wiped out before reaching maturity. I have observed many such occurrences among colonies of *Macoma*, *Tagelus*, *Schizothaerus*, *Sanguinolaria*, *Barnea*, *Pholadidea*, *Zirfaea*, *Tellina*, *Donax*, *Mactra*, and the mussels. The establishment of a permanent colony is rare. Of course, this is not surprising when one considers that most female pelecypods lay eggs in quantities exceeding a million at a time, and may lay several times per season (Galtsoff, 1930).

The fronds of a single plant of *Pelagophycus porra* Setchell which was picked up as it was floating by the laboratory were covered on both sides by the scallop, *Pecten latiauritus monotimeris* Conrad (Pl. 2, Fig. 1). There was an average of 285 of these molluscs per square foot of frond surface, making a total of 85,080 on this one plant. Undoubtedly a brood of this pecten had been carried by the current to the neighborhood of this seaweed, and had used the seaweed as a place of attachment when time for settling came. They were all of a uniform size, ranging between 13 and 15 mm. in diameter. There was also an indication that a great many had fallen off. A flatworm which was present in considerable numbers was devouring them at a great rate. It is doubtful that any of the pectens would have reached maturity on this plant. They just happened to settle there.

I think this accounts for the fact that a small clam, *Donax gouldii* Dall, settles in patches along the shores of Southern California. Often they are washed out by a single tide, and at such times hundreds of pounds of them are usually gathered by people and made into chowder.

The mussel, *Mytilus californianus* Conrad, and starfish, *Pisaster ochraceus* (Brandt), follow a cycle of succession as definite as that of the rabbit and the bobcat. When the number of mussels becomes great, the starfish increases proportionately and devours the bed of mussels. The starfish then becomes scarce and the mussels reestablish themselves, only to have the cycle repeat itself. The cycle takes from five to ten years, or even longer. However, at no place are the mussels entirely exterminated, and in some places factors which are disadvantageous to the starfishes may exert themselves to such an extent that the mussel beds are not greatly harmed. A starfish may cling to a rock as strongly as a mussel when it gives its whole attention to the act, but when it goes in search of food, as it must, it is not able to withstand the heavy beating of the surf that a mussel bed can. Another factor which prevents a mussel bed from ever being exterminated is that the mussels are able to live farther above low tide mark than can starfishes. A starfish might have time to make a trip to the highest mussel when the tide is in, but it would not have time to tent up over the mussel, open it and digest it. Mussels can close their valves and withstand drying between tides, but starfishes cannot. In those places where mussels are not cleaned up by starfishes, they attach one on top of the other until the bed becomes so thick that the lower ones are smothered, and a heavy storm will often wash rocks almost entirely bare of mussels, so that, even though the starfishes do not destroy them, they destroy and reestablish themselves. In the northern part of their range, where the surf is heavy, this latter type of succession may readily be observed, while in Southern California the starfish-mussel cycle is more evident.

Cephalopoda

In contrast with *Paroctopus bimaculatus* Verrill, which subsists mainly on shell fish, *P. apollyon* Berry feeds chiefly on crabs. The young of *P. apollyon* feed on hermit crabs, which they pull from the shells and devour. As these octopi grow larger, they use larger crabs for food, using the web between their

tentacles to fold around their prey. In an aquarium an octopus attacked a crab so large that it could not be entirely surrounded by the web; so the octopus, by spreading its tentacles out on the glass, tented up over the crab and pressed it against the glass. When it was first seized, the crab made a few vigorous struggles, one cheliped grasping an edge of the web. Within 20 seconds this cheliped, as well as the other, opened wide, in the manner assumed when the crab take a defensive attitude, then slowly began to close. As the chelae closed, the abdomen began to unbend in the manner characteristic of death, the left maxilliped opened, then the right, the appendages quivered, and from the branchial canals issued a slight brownish coloration. At the end of 45 seconds the crab was, to all outward appearances, entirely dead. During this time the crab was in no way attacked by the beak of the octopus, and it was not eaten until 20 minutes later. Crabs are no doubt killed by a secretion from the "salivary" glands, of which the octopus has two pairs, one pair being fairly large. In order to eat the crab the octopus opened it at the dorsal juncture between carapace and abdomen, the place where the break comes when a crab molts. The octopus then pulled off the back of the crab, ate the viscera first, dropped the back, and then one by one pulled off the legs, cleaned out and ate the contents, and dropped the empty shell of each as it was finished.

The southern species, *Paroctopus bimaculatus*, has a permanent secluded, dark cavity in which it lives, and from which it issues forth at dusk in search of its food. It may even build its own burrow in an old shell bed, or under a rock or other object. It has the habit of gathering loose shells with which to close the entrance of its burrow during the daytime. Because of this habit, its burrows are easily found on the mud flats when the tide is out. When in search of food it glides smoothly over the mud, inserting a tentacle into this or that opening. Those octopi living in proximity to mussel beds live mainly on mussels, while others farther up the estuary live mainly on pectens. Both *Pecten circularis aequisulcatus* Carpenter and *P. latiauritus monotimeris* Conrad are fairly abundant in such localities, the former lying loose on the mud flats, the latter attaching by a byssus thread to the eel grass, *Zostera*.

Eggs of the squid, *Loligo opalescens* Berry, are laid in long finger-like bunches which are attached to anything on the ocean bottom that is solid, such as seaweed, rocks, shells, or debris. The bunches may contain over 100 "fingers." One hundred nineteen were counted in one cluster, but one finger contained only empty egg capsules. Such a cluster may have been laid by more than one squid. Many other molluscs will lay a number of empty capsules at the end of a spawning. The length of time for development within the egg case varies from twenty-one to twenty-eight days. This difference in time may be due to a difference in the amount of yolk in particular batches of eggs. I have observed that toward the latter part of the development time, if the embryos with a small amount of yolk sac still remaining are taken from the egg capsule, they will drop the remaining yolk sac, and will become, to all appearances, fully developed embryos ready to meet the outside environment. Hatching of a cluster of eggs continues over a period

of about one week. This may indicate that a cluster of squid eggs is laid by one individual, and that it requires about one week to lay them. The average number of eggs per finger is about one hundred. When the fingers are laid, they are about one inch long and one fourth inch in diameter, but the jelly surrounding them takes in water and swells until the finger becomes about three fourths of an inch in diameter and three and one half inches long and each egg is surrounded by a considerable space.

During the spawning season, which occurs mainly during April, May, June, and July, the season being earlier in the southern and later in the northern part of the range of the squid, the eggs are so plentiful and conspicuous it would seem that few of them would escape being eaten by other animals. Such, however, is not the case, for the eggs are seldom eaten by any other animal. Perhaps one of the worst enemies is the annelid worm, *Capitella dizonata*, which develops in the jelly at the same time with the embryo squids, but by the time the worms have devoured the greater portion of the jelly surrounding the embryos, the latter hatch. The jelly which surrounds the egg capsules in the fingers not only seems to hold no attraction as food for other animals, but is actually very difficult to digest. A finger of eggs which was fed to an anemone was ingested and then disgorged after two hours, none the worse for the experience. At another time a starfish, *Patiria miniata*, surrounded a finger of eggs with its stomach, holding the gelatinous mass against the glass wall of the aquarium for between 76 and 77 hours before maceration began to take place. The finger of eggs was then digested by the starfish during the next 24 hours. It is doubtful if this starfish would have attempted to eat these eggs had it not been in the aquarium without food.

Enteropneusta

The balanoglossid, *Dolichoglossus pusillus*, Ritter is very abundant both at Newport Bay and Anaheim Slough. Development in this animal is not direct (Davis, 1908), but the tornaria swim for only a few hours before settling. Shedding of eggs seems to be almost a continuous process, and only a few tornaria may be obtained during any one tide.

Pisces

Because of their shape, serpents have an advantage in that they are able to enter places in search of food that otherwise would be inaccessible. The moray eel, *Gymnothorax mordax* (Ayres), which lives along the rocky coasts of Southern and Lower California, no doubt is successful for exactly the same reason. Its muscular serpent-like body allows it to slide among the narrow crevices and into the darkest corners of rock piles in search of food. Its food consists almost exclusively of octopi. If the octopus is small enough, it is swallowed whole. When the octopus adheres firmly to the head of the eel with its tentacles, the eel throws a loop in the posterior portion of its body and pulls its head quickly backward through this loop. This loosens the octopus by sliding the sucking cups of the tentacles from the eel's head. If the pull is at right angles to the surface adhered to, the sucking cup of an octopus will hold very firmly to the eel, but the cups will slide along the

surface easily, and this accounts for the ability of the eel to so quickly slide octopus tentacles from its head. This performance may be repeated several times during the time an eel is swallowing an octopus. If the octopus is too large to be swallowed whole, the eel will grasp a single tentacle in its mouth and rotate its body so rapidly that the tentacle is quickly twisted from the octopus. This spinning movement is executed rapidly and requires practically no more space for its execution than a hole large enough to accommodate the straightened body of the eel. The eel makes practically no use of its eyes in searching out its prey, but depends altogether upon scent and movement. Moray eels are attracted by movement, and I have known them to come from their hiding places to investigate my hand as it moved about in the water when taking specimens. Abalone fishermen are seldom bitten by the eels, probably because of the commotion they make while searching for the abalones. However, many people have been bitten by these eels, and only last summer a man who had one of his fingers badly lacerated by an eel came to the laboratory for first aid.

After an eel has been exposed to the ink discharged by an octopus it is unable to locate the cephalopod, even though it may come in contact with it. This inhibiting effect upon its senses usually lasts for more than an hour. Octopi are instinctively afraid of the moray eel and will often discharge their ink into the water even though the eel comes no closer than within a foot or two of their body. In this case at least, the ink of the octopus is efficient not because of its blinding effect, but because of its inhibition on the sense of smell.

After a moray eel is kept in the laboratory for some time without its natural food it will gladly accept mussels which are taken from the shell. If one holds the mussel meat firmly by means of the byssus threads the eel will throw a loop in its body and jerk ones hand loose from the material. It will do this even if lifted entirely above the water.

Too, if a fish is handled until it has discharged its mucus over its surface and then is replaced in the aquarium, the eel will begin looking for it just as he does if an octopus is placed in the aquarium, and will eat the fish if he can catch it. This is another reason why I think that the eel hunts by scent and movement rather than by sight.

The ocean sunfish, *Mola mola* (Linnaeus), uses Scyphozoa (jelly-fish) for food, perhaps exclusively. This is not an original statement, but because of the fact that recent publications have stated that the food of this fish is not known, and since one even goes so far as to suggest plankton as a possible source of food (Tibby, 1936), the statement is repeated here. I have seen *Mola mola* eating jelly-fish many times. The fish begins at the edge of the bell and devours the jellyfish bite by bite, then moves to another and repeats the process, eating one jellyfish after another. The extremely small size of the mouth and gill slits would preclude the possibility of this fish making use of plankton for food. Even though it possessed a larger mouth and gill openings, it would still of necessity have to be equipped with some form of gill raker for straining out the plankton, and would also have to be

equipped with locomotory organs much more efficient than those it now possesses. It is a very slow swimming fish, and one can often approach within a few feet of it without making any effort to move away. Jellyfish may seem a meager diet, but when one considers that the mesogloea of these animals may be rather well supplied with food stored in amoebocyte cells, it is evident that the nutrient value of jellyfish may be much greater than one would at first suppose.

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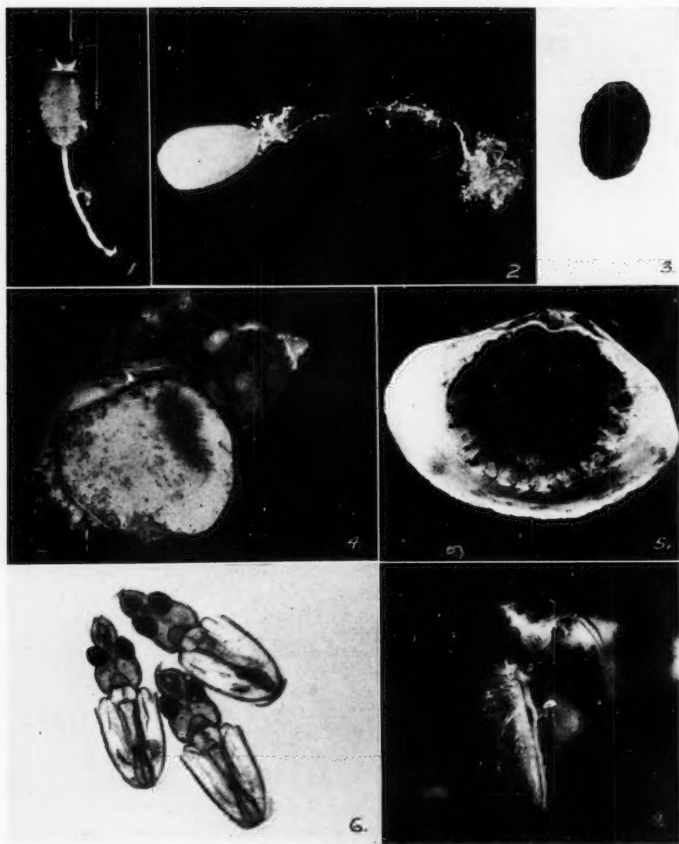


PLATE 1

FIGURES

1. *Sycon coronatum* (?), with male and female commensal isopod. x3.
2. *Tetilla mutabilis*, showing holdfast. x1.
3. Same, at time of release from holdfast. x $\frac{1}{2}$.
4. *Bursa californica*. x $\frac{1}{2}$.
5. "Nest" of empty capsules of *Bursa californica*. x $\frac{1}{2}$.
6. Larval squid, *Loligo opalescens*, just hatched. x12.
7. *Antipella auriocincta* eating *Corymorpha palma*. x1.

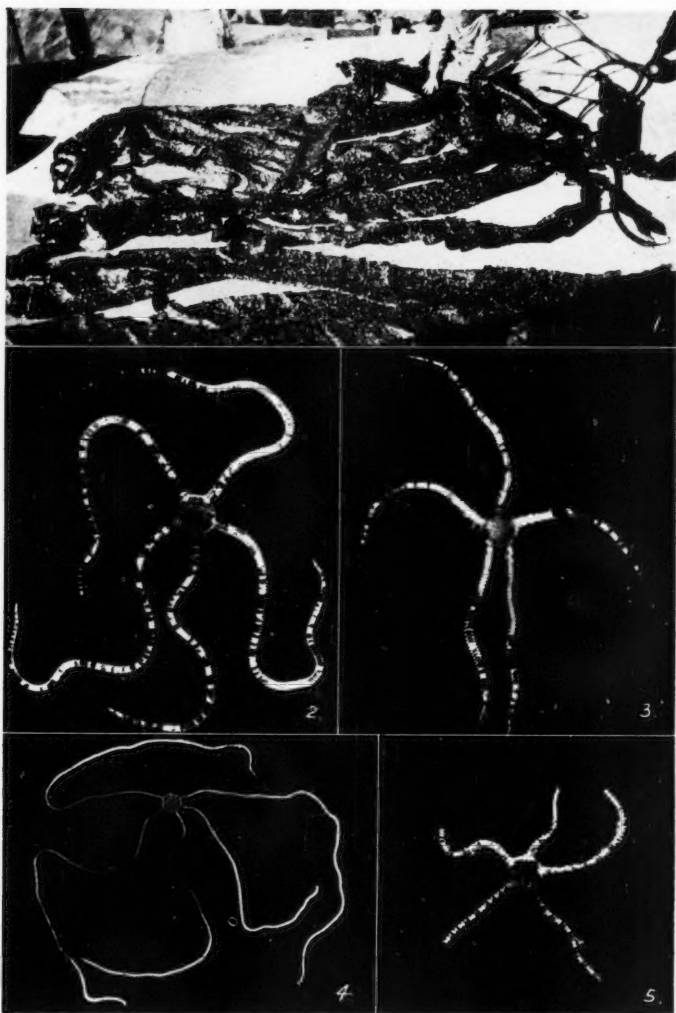


PLATE 2: Figs. 1-5—(1) Fronds of *Pelagophycus porra* covered by the scallop, *Pecten latiauritus monotimeris*. (2) *Amphiodia psara*, with arms too long for swimming. $\times \frac{2}{3}$. (3) Same, typical swimming stage. $\times 2$. (4) *Amphiodia barbarae*. $\times \frac{1}{2}$. (5) *Ophiacantha carythra*. $\times 1\frac{1}{2}$. This particular individual swam at intervals for two days in a laboratory aquarium.

Additional Species of North American *Gyrodactyloidea* (Trematoda)*

Justus F. Mueller

The material forming the basis of the present paper was collected during the summer of 1937, while the author was serving as parasitologist with the Biological Survey of the New York State Conservation Department under the direction of Dr. Emmeline Moore. The author is indebted to the Conservation Department for the opportunity of gathering this material and for permission to publish the present paper.

In a previous paper (Mueller, 1936), on the basis of information then available, the author commented on the apparent absence of members of the genus *Dactylogyrus* from the North American fauna, and suggested that this genus might be more or less limited to Europe. With the findings given in the present article, however, it is clear that this inference was erroneous. The earlier work on the *Gyrodactyloidea* in North America failed to disclose species of the genus *Dactylogyrus* because until recently the game fish were examined more or less to the exclusion of other fishes. It is now clear that while *Dactylogyrus* does not occur on our native game fishes, numerous species of this genus do occur on the various native minnows and suckers.

In the present paper 22 new species of *Gyrodactyloidea* are described. Of these 16 belong to the genus *Dactylogyrus*; 5 of the others belong to the *Tetraonchinae*. The remaining form is a trematode of uncertain position, possessing characters which cannot be reconciled with the usual division of the *Monopisthocotylea* into subfamilies.

Cotypes of all of the following species will eventually be deposited in the U. S. National Museum.

Anonchohaptor gen. nov.

Definition: *Monopisthocotylea*, but having characters of both the superfamilies: *Gyrodactyloidea* and *Capsaloidea*. Head with large lappets, 4 eyes present, posterior haptor disc-like, without large hooks (anchors) or bars; 14 small hooks present, 12 marginal, and 2 central. Cirrus complex consisting of a tapering cuticular tube and an accessory piece, opening on median ventral Vagina ventral, on right margin. Ovary loops around right limb of intestine,

* After this paper had been sent to the editors, there came to the attention of the writer a paper by J. D. Mizelle, which appeared in the Amer. Midl. Nat. for July, 1937, Vol. 18, No. 4, pp. 612-621, describing three new species of *Dactylogyrus* from the blunt-nosed minnow. This makes a total of five species of the genus known for this country before publication of the present paper.

oviduct joins ootype complex on ventral side of intestinal crura. A large shell gland present, the cells of which extend from the region of the uterus to in back of the testis. Intestine with two crura joined by a transverse commissure posterior to the genital complex. Vitellaria distributed over body from pharynx to in back of intestine. Type species: *Anonchohaptor anomalum*.

I am indebted to Dr. E. W. Price of the Bureau of Animal Industry for the following comments on this form, contained in a personal letter.

This worm (appears to have) characters of both superfamilies. In some respects it is quite like *Fridericianella*, if allowance be made for possible errors of observation by Brandes. The looping of the ovary around one of the intestinal limbs is a more or less constant character of the *Monocotylidae* (*Capsaloidea*). The absence of large hooks (anchors) and bars is characteristic of *Fridericianella*, although eyes are supposed to be missing in the latter genus. The H-like formation of the gut is like both *Fridericianella* and *Anoplodiscus*. The nature of the copulatory organ is definitely of the type occurring in the *Gyrodactyloidea* (*Dactylogyridae* and *Calceostomatidae*) and not that of the *Capsaloidea*. The anterior end of this form seems more capsaloid than gyroductyloid. Personally, I am rather of the opinion that the form should be referred to the *Calceostomatidae* (*Gyrodactyloidea*).

It will be seen from the above that the position of the present form is for the time being very much in doubt. A detailed study, beyond the limits of this paper will be published at a future date with the purpose of clearing up the question of relationships.

***Anonchohaptor anomalum* sp. nov.**

Pl. 1, Figs. 1-6

Hosts: *Catostomus commersonnii*, *Hypentelium nigricans*, *Moxostoma duquesnei*, Chautauqua Lake, N. Y.

Fair sized worms, about 2.5 mm. long by 1 mm. wide. Haptor disc-like, well separated from body. Hooks as given above for genus. Cirrus small, provided with an accessory piece, and opening on the mid-ventral line. Vagina consisting of a thin, irregularly coiled tube, opening on the ventral surface to the right of and slightly posterior to the cirrus. Head lappets large and prominent. Large gland cells lying in anterior lateral regions open on the lappets. Four eyes present. Pharynx large, intestine single for a short distance and then divided around genital complex. The two crura continue backward, but are joined by a transverse commissure posteriorly. Ovary dorsal, passes around right side of body exterior to the right intestinal limb to join the ootype. Uterus opens near the cirrus. Oviduct, yolk ducts and the duct from the seminal receptacle (vagina) come together near the center of the body and lead into the uterus. The ootype is surrounded by the shell gland which is very large, occupying most of the space between the anterior fork of the intestine and the posterior commissure. The vitellaria form a broad envelope all over the body from the posterior margin of the pharynx to in back of the intestine. The testis is relatively small, situated posterior to the ovary and dorsal to the shell gland on the dorsal surface.

There are slight differences in worms taken from different hosts but these are insufficient to justify separation into different species. Usually only 5 or 6 worms were present on the gills of any one fish.

Murraytrema copulata sp. nov.

Pl. 1, Figs. 7-13

Hosts: *Calostomus commersonii*, *Hypentelium nigricans*, *Moxostoma anisurum*, *Mox. erythrurum*, Chautauqua Lake, and French Creek, near Panama, N. Y.

Occurring on gills of host. Moderately large worms, length varying with state of contraction from 1.5 to 3 mm. and width from 0.25 to 0.50 mm. Haptor wedge shaped, with 3 bars, characteristic of the genus. Central bar (ventral) 0.06 mm. long, the two dorsal bars approximately the same dimension. The central bar of worms from *C. commersonii* differs slightly from the same bar in worms from other hosts. Ventral and dorsal anchors approximately equal in length, 0.074 mm. in specimens from *C. commersonii*, but ventral somewhat smaller in the forms from *H. nigricans* and *Moxostoma*. Hooks 14 in number, of equal size, and small, without inflated bases, pairs 1 to 6 lying around the edge of the haptor, pair 7 between the shafts of the ventral anchors. Pairs 1 and 7 are on the ventral surface, 2 to 6 on the dorsal. The cirrus is a tapering tube, bent near the base and in the middle, and tapering to a point distally. Near the middle bend it has a prominent angular projection. The accessory piece is of irregular outline, but possessing 3 arms, between two of which passes the tip of the cirrus. Vagina opens in the ventral median area to the right of and slightly posterior to the cirrus. In worms from *H. nigricans* and *Moxostoma*, it is very long and tightly coiled, but in the forms from *C. commersonii* it is shorter and winds irregularly. Four eyes are present, the posterior pair larger and farther apart than the anterior.

My specimens were taken from the gills of the hosts early in June, and were frequently found in copula. This species constitutes the second for the genus, and the first reported for North America. Because of differences in the bars, anchors, and vagina in the specimens from the common sucker it is possible that two species may be represented. Until further work indicates this to be the case, I am assuming there is only a single species. I am designating as the cotypes worms from *H. nigricans*, at French Creek, near Panama, N. Y.

Cleidodiscus brachus sp. nov.

Pl. 2, Figs. 1-9, 25-31

Hosts: *Semotilus atromaculatus*, *Margariscus margarita*, French Creek, near Panama, N. Y.

On gills of the host. Fair sized worms for the genus, as much as 1.2 mm. long by about 0.18 mm. wide, but at times much smaller. Haptor wedge shaped, not markedly set off from body. Ventral bar larger than dorsal. Ventral anchor larger than dorsal and with peculiar transverse thickening between root and shaft. Greatest length of ventral anchor 0.050 mm. Greatest length of dorsal anchor 0.046 mm. Hooks small and slender, 7th pair not observed. First pair on median ventral surface of haptor. Hooks 2 to 6 on lateral edges of haptor. Hooks about equal in size, 0.023 mm. long. Cirrus short, with characteristic form. Accessory piece with sharp point and forked base. Vagina not certainly observed in my specimens, but apparently on left. Four eyes present, the anterior slightly closer together than the posterior.

A well defined species, easily recognized by the character of the cirrus and anchors. The egg is broadly ovate in specimens from *Semotilus*, but at times has a peculiar swelling at one end in specimens from *Margariscus* (Pl. 2, Fig. 31).

***Cleidodiscus alatus* sp. nov.**

Pl. 2, Figs. 17-24

Host: *Ambloplites rupestris*, Chautauqua Lake, N. Y.

Medium sized forms, 0.44 mm. long by 0.088 mm. wide. Haptor wedge shaped, bars non-articulate, ventral bar larger than dorsal. Ventral bar 0.040 mm. long, dorsal 0.030 mm. Ventral anchors 0.040 mm. in greatest straight dimension, dorsal 0.030 mm. Shafts of anchors hollow. Hooks small, 0.020 mm. long. Cirrus with large expanded base and large flattened or slightly convex accessory piece with a thickened edge. The vagina is prominently cuticularized, and lies on the left margin posterior to the cirrus. Eyes 4 in number, posterior pair larger and farther apart than anterior.

***Cleidodiscus malleus* sp. nov.**

Pl. 3, Figs. 1-6

Hosts: *Percina caprodes*, *Hadropterus maculatus*, Chautauqua Lake, N. Y.

Small, rather robust forms, in a contracted state measuring about 0.37 mm. long, by 0.22 mm. wide. Haptor with 2 bars similar in character and not articulated. Ventral bar from 0.03 to 0.035 mm. long. Dorsal bar slightly larger, about 0.045 mm. Dorsal and ventral anchors rather similar in size, about 0.035 mm. in greatest length. Hooks small, about 0.017 mm. in length, arrangement characteristic of the genus. First pair on ventral surface of haptor between roots of ventral anchors; pairs 2 to 6 on lateral edges of haptor, pair 7 on posterior aspect between shafts of ventral anchors. Cirrus short, with narrow spiral fin. Tip of cirrus with a pronounced flange. Accessory piece small, length of cirrus about 0.034 mm. Vagina not observed. Pharynx 0.047 mm. in diam. Posterior pair of eyes larger and more widely separated than the anterior.

***Tetracleidus chautauquaensis* sp. nov.**

Pl. 2, Figs. 10-16

Host: *Ambloplites rupestris*, Chautauqua Lake, N. Y.

Moderately large forms, about 1 mm. in length by 0.2 mm. in width. Haptor wedge shaped, 2 bars present, not articulated, about equal in size, 0.023 mm. long, dorsal bar more ornate than ventral. Anchors 0.04 mm. in greatest straight dimension, all 4 similar in shape and size. Hooks 0.03 mm. in length. Pairs 1 to 6 with typical arrangement, pair 7 not observed. Cirrus a long delicate tube with a spiral fin making 4 complete turns. Accessory piece present. The vagina has a wide fleshy lip and opens on the left margin of the body thereby placing the form in the genus *Tetracleidus*. This is the second member of this genus so far described. Four eyes present, the posterior pair larger and more widely separated than the anterior.

Dactylogyrus apos sp. nov.

Pl. 4, Figs. 15-24

Host: *Hypentelium nigricans*, French Creek, near Panama, N. Y.

Small forms, total length about 0.444 mm., width 0.07 mm. Four eyes present, anterior pair widely spaced, posterior close together. Haptor with two bars, the dorsal articulated with the anchors, 0.032 mm in length; the ventral small, only about 0.014 mm. in length, and very narrow. The anchors face towards the dorsal surface, and are 0.048 mm. in greatest length. Hooks 0.028 mm. in length. Fourteen are present, all approximately equal in size. Cirrus relatively robust with a well defined accessory piece bearing 3 arms, one of which articulates with the base of the cirrus, another curves around the tip of the cirrus, while the third ends in two small points. The vagina opens on the ventral surface somewhat posterior to the cirrus and bears a heavily cuticularized vestibule which appears to be closed by a fleshy plug.

Fairly abundant on the gills of its host, found in association with *Murraytrema copulata* and *Anonchohaptor anomalum*.

Dactylogyrus photogenis sp. nov.

Pl. 4, Figs. 29-33

Host: *Notropis photogenis*, French Creek, near Panama, N. Y.

Small forms, about 0.43 mm. long by 0.088 mm. wide. Two bars in haptor, the dorsal 0.03 mm. long, and robust, the ventral small and slender, 0.021 mm. long. Anchors 0.040 mm. in greatest dimension; hooks 14 in number, equal in length, about 0.023 mm. long; arrangement typical of the genus. Cirrus slender, tubular, and sharply recurved at its distal end, with base drawn out to a point toward one side. Accessory piece slender, articulating with base of cirrus, and forked distally. Largest straight dimension of cirrus and accessory piece is 0.026 mm. Pharynx about 0.026 mm. in greatest diameter. Eyes large and prominent, about equal in size, anterior and posterior pairs evenly spaced. Vagina not observed.

Dactylogyrus acus sp. nov.

Pl. 4, Figs. 6-10

Hosts: *Notropis cornutus*, *Camptostoma anomalum*, French Creek, near Panama, N. Y.

Fair sized worms, 0.9 mm. long by 0.15 mm. wide. Two bars present, the dorsal robust, 0.030 mm. long, the ventral slender, of approximately the same length. Anchors 0.041 mm. in greatest length; 14 hooks present, arrangement characteristic of the genus, all of about the same size, 0.023 mm. long. Cirrus tubular, slightly curved, with expanded base. Accessory piece forked, one limb curving around tip of cirrus, and accompanied by a less refractile piece which lies parallel to the shaft and follows along this prong. Greatest dimension of cirrus from tip to edge of expanded base 0.065 mm. Vagina not observed. Four eyes present, anterior and posterior pairs equally spaced.

Dactylogyrus confusus sp. nov.

Pl. 4, Figs. 1-5

Host: *Clinostomus elongatus*, French Creek, near Panama, N. Y.

Small forms, 0.48 mm. long, 0.074 mm. wide. Haptor with 2 bars,

ventral small and slender, the dorsal robust. Anchors 0.027 mm. long in greatest straight dimension. Hooks 14 in number; arrangement typical, equal in size, 0.019 mm. long. Cirrus curving, tubular, with large expanded base. Accessory piece trifid, with a bar of softer density curving over it and fused with it. Vagina conspicuous, with a large chitinized vestibule, lying on ventral surface posterior to cirrus. Eyes about equally spaced. Cirrus similar in character to that of *Dact. acus*, but much smaller. The two species can be distinguished readily on size, and also by the shape of the anchors and other hard parts.

***Dactylogyrus tenax* sp. nov.**

Pl. 4, Figs. 25-28

Host: *Semotilus atromaculatus*, French Creek, near Panama, N. Y.

Fairly large *Dactylogyrus*, total length about 1 mm., width about 0.2 mm. Haptor apparently with only a single bar, the dorsal, which is robust, 0.03 mm. long. Anchors 0.04 mm. long. Hooks rather large with inflated shafts, 0.035 mm. long, about equal in size, arrangement typical. Cirrus straight, 0.049 mm. long, tubular, with accessory piece divided distally into three cusps. Vagina not observed. Four eyes present, anterior slightly closer together than posterior. A well defined species, readily recognized on characters of the cirrus and haptor.

***Dactylogyrus microphallus* sp. nov.**

Pl. 4, Figs. 11-14

Host: *Semotilus atromaculatus*, French Creek, near Panama, N. Y.

Small forms, 0.5 long, by 0.08 mm. wide, Haptor with only a single bar, the dorsal, 0.035 mm. long. Anchors 0.035 mm. in greatest straight dimension. Hooks 14 in number, arrangement typical of the genus. They are equal in size, 0.021 mm. long. Cirrus 0.035 mm. long. Accessory piece slender with a lateral prong and curving point. Four eyes present, anterior pair slightly farther apart than the posterior. This species is well characterized by the shape of the anchors and the cirrus complex.

***Dactylogyrus duquesni* sp. nov.**

Pl. 5, Figs. 18-25

Host: *Moxostoma duquesni*, French Creek, near Panama, N. Y.

Small forms, 0.35 mm. long, by 0.074 mm. wide. Haptor characteristic of the genus, with two bars. Dorsal bar large, robust, 0.03 mm. long. Ventral bar 0.014 mm. Anchors slender with long shafts and points, 0.039 mm. long. Hooks of two different sizes, those on the ventral surface smaller than those on the lateral edges of the haptor. Lateral hooks 0.03 mm. long, ventral hooks 0.021 mm. Cirrus small, 0.026 mm. in greatest straight dimension, with an expanded base and curved tapering distal part. Accessory piece consists of a broad curved base and sharply pointed extremity which usually lies close to the tip of the cirrus, but may be drawn away from it as in Plate V, Fig. 25. The vagina lies on the ventral surface near the right edge and has a cuticularized part just inside the lip in the form of a disc with a raised central stem, much like an inverted mushroom. The pharynx is small, 0.021 mm. in diameter, and the two pairs of eyes are equally spaced.

Dactylogyrus urus sp. nov.

Pl. 5, Figs. 1-5

Host: *Moxostoma anisurum*, French Creek, near Panama, N. Y.

Moderate sized forms, 0.5 mm. long, by 0.125 mm. wide. Haptor with 2 bars, the ventral very small and ill defined, 0.014 mm. long; the dorsal rugged, 0.030 mm. long. The anchors are slender, about 0.05 mm. in greatest straight dimension. Hooks approximately equal in size, 0.03 mm. long. Cirrus large, with a simple base and fairly straight throughout its length, 0.05 mm. long. Accessory piece stout, with a prominent lateral arm about midway of its length, and a very characteristic distal extremity. Vagina on the ventral surface near right margin with prominent cuticularized lip. Pharynx small, 0.026 mm. in diameter. Eyes equally spaced. In my specimens the 4 cephalic papillae are very prominent.

Dactylogyrus rubellus sp. nov.

Pl. 5, Figs. 6-12

Host: *Notropis rubellus*, French Creek, near Panama, N. Y.

Small forms, 0.3 mm. to 0.37 mm. long. Haptor typical of the genus, with 2 bars, the ventral very small and vestigial, 0.018 mm. long, the dorsal rugged 0.025 mm. long. Anchors 0.032 mm. in greatest straight dimension, with a very long superficial root. Hooks unusually small and slender, 0.016 mm. long. Cirrus large, with a much expanded base, and conspicuous accessory piece, which has a prominent arm midway of its length. Greatest length of cirrus 0.050 mm., of accessory piece 0.034 mm. Vagina posterior to cirrus on ventral surface near right margin. It has a wide mouth a short distance inside of which there appears a bent heavily cuticularized body in close contact with a fleshy plug. Pharynx small, 0.023 mm. in diam. Two pairs of eyes present, posterior pair slightly larger and somewhat closer together than the anterior.

Dactylogyrus orchis sp. nov.

Pl. 3, Figs. 13-17

Host: *Notropis rubellus*, French Creek, near Panama, N. Y.

Small forms, about 0.35 mm. long, by 0.071 mm. wide. Haptor with 2 bars, the ventral vestigial, about 0.013 mm. long, the dorsal larger, 0.017 mm. Anchors slender, about 0.032 mm. in greatest dimension. Hooks small, small, about 0.02 mm. long. General plan of haptor characteristic of the genus. Cirrus very small, about 0.017 mm. in greatest dimension. Accessory piece minute with three arms approximately equal in length. Vagina not observed. Pharynx about 0.017 mm. in diameter. Eyes about equal in size, anterior and posterior pairs equally spaced. By the extremely small size and characteristic form of its hard parts this species is easily recognized.

Dactylogyrus amblops sp. nov.

Pl. 3, Figs. 28-34

Host: *Hybopsis amblops*, French Creek, near Panama, N. Y.

Small forms, 0.35 mm. long by 0.09 mm. wide. Haptor well set off from body, with 2 bars, the ventral vestigial, 0.019 mm. long, the dorsal well

developed, 0.023 mm. long. Anchors rather short and with wide roots; greatest dimension 0.033 mm. Superficial root greatly elongated. Hooks approximately equal in size, with arrangement characteristic of the genus. Cirrus consists of an arcuate tapering tube with a simple base, 0.046 mm. long. Accessory piece with two short wide roots and a bent pointed extremity. Vagina on right ventral margin, with prominent cuticularized lip in form of a thick crescent. Pharynx small, 0.023 mm. in diameter. Anterior and posterior pairs of eyes about equal in size. Posterior pair slightly closer together. This species is somewhat similar to *Dactylogyrus perlus*, but can be easily distinguished by its much larger cirrus.

***Dactylogyrus perlus* sp. nov.**

Pl. 3, Figs. 18-22

Host: *Notropis cornutus*, Chautauqua Lake, N. Y.

Much like *D. amblops*, but the cirrus is smaller and more delicate. General dimensions of worm about 0.035 by 0.09 mm. Haptor well set off from body, with 2 bars, the ventral vestigial. Anchors 0.028 mm. in greatest straight dimension, somewhat smaller than those of *amblops*; hooks small, 0.018 mm. long. Cirrus arcuate, tapering, with characteristic expanded base, greatest dimension about 0.035 mm. accessory piece much as in *amblops*, but roots more slender. Vagina on right margin with a heavy cuticularized lip, somewhat granular in appearance; Pharynx 0.023 mm. in diameter. Anterior and posterior pairs of eyes equal in size and equally separated.

***Dactylogyrus scutatus* sp. nov.**

Pl. 5, Figs. 13-17

Host: *Parexoglossum laurae*, *Exoglossum maxillina*, French Creek, N. Y.

Fair sized worms, 0.4 mm. long by 0.12 mm. wide. Haptor with two bars, ventral bar very characteristic, having a long anterior projection passing between the first pair of hooks. The first and seventh pairs of hooks are placed on a raised portion of the haptor, along with the ventral bar. Hooks 2 to 6 lie around the lateral edges of the haptor. The dorsal bar may be straight and plain, or somewhat curved and sculptured in different individuals. Anchors about 0.050 mm. in greatest dimension. Hooks large, about equal in size, 0.026 mm. long. Cirrus very small and simple, with a small accessory piece. Vagina not observed. Pharynx about 0.032 mm. in diameter. Eyes 4 in number, posterior pair usually larger and farther apart than anterior, though this condition may be reversed. This species is easily recognized by the character of the ventral bar.

***Dactylogyrus bulbosus* sp. nov.**

Pl. 3, Figs. 23-27

Host: *Notropis cornutus*, Chautauqua Lake, N. Y.

Small forms, about 0.38 mm. by 0.2 mm. Haptor with two bars, ventral vestigial, dorsal well formed, and about 0.022 mm. long. Anchors slender, about 0.035 mm. long. Cirrus very characteristic with a bulbous inflation at the tip. Accessory piece in form of a bent bar, with pointed tip, and

an arm about midway of its length. Vagina present on right ventral margin, but not conspicuous. Egg broadly ellipsoidal, 0.06 by 0.04 mm. with a small filament at one end. Pharynx 0.026 mm. in diameter. Posterior pair of eyes slightly larger and farther apart than anterior. The species is easily distinguished by the bulbous tip of the cirrus.

***Dactylogyrus cornutus* sp. nov.**

Plate 3, Figs. 7-12

Host: *Notropis cornutus*, Chautauqua Lake, N. Y.

Small forms, about 0.35 mm. long by 0.08 mm. wide. Haptor with 2 bars, ventral rather larger than in most forms, dorsal robust, about 0.03 mm. long. Anchors slender, about 0.039 mm. long. Hooks large, equal in size, arrangement typical. Cirrus a long slender narrow tube of uniform diameter throughout its length. It may be straight or bent in different worms. A small accessory piece lies in contact with its base. Vagina present on right in form of a simple vestibule without thickened walls. Egg ellipsoidal, 0.055 mm. by 0.040 mm. Pharynx small, 0.026 mm. in diameter. Eyes equally spaced and equal in size. This form is easily distinguished by the character of the cirrus.

***Dactylogyrus fulcrum* sp. nov.**

Pl. 5, Figs. 26-32

Host: *Notropis cornutus*, Chautauqua Lake, N. Y.

Small forms, about 0.3 mm. long by 0.07 mm. wide. Haptor with 2 bars, the ventral rather well developed and having a conspicuous anterior projection at the mid point. Dorsal bar rugged. Both bars of about equal length, 0.03 mm. long. Anchors slender, 0.037 mm. long. Hooks conspicuous, equal in size, arrangement typical. Cirrus arcuate, tapering, with expanded base. Accessory piece with a pointed bent tip, and a blunt projection about 1/3 of its length from the base. Vagina present on right ventral margin, without cuticular thickening. Pharynx about 0.017 mm. in diameter. Eyes about equally spaced, posterior pair slightly larger than anterior.

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Abbreviations: AP—accessory piece, CIR—cirrus, CG—cephalic glands, DA—dorsal anchors, DB—dorsal bar, INT—intestine, LAP—lappets, OV—ovary, SG—shell gland, SR—seminal receptacle, TES—testis, UT—uterus, VA—ventral anchors, VAG—vagina, VB—ventral bar, VIT—vitellaria.

PLATE I

Anonchohaptor anomalum

1. Entire worm, composite drawing from several different specimens, ventral surface uppermost. One of the hooks enlarged beside the haptor, drawn to same scale as Fig. 6.—2. Composite transverse section near level of genital complex, showing relative position of different parts of the female system.—3. Transverse section just posterior to pharynx.—4. Transverse section at level of testis.—5. Cirrus and accessory piece.—6. Vagina.

Murraytrema copulata.

7. Haptor of worm from *H. nigricans*.—8. Vagina of worm from *H. nigricans*.—9. Vagina of worm from *C. commersonnii*.—10. Egg.—11. Cirrus of worm from *H. nigricans*.—12. Cirrus of worm from *C. commersonnii*.—13. Anchors and bars of worm from *C. commersonnii*.

PLATE 2

Cleidodiscus brachus, from *Sem. atromaculatus*.

1. Ventral anchor.—2. Dorsal anchor.—3. Egg.—4, 5. Two examples of ventral bar.—6. Dorsal bar.—7, 8. Hooks.—9. Cirrus and accessory piece.

Cleidodiscus chautauquaensis, from *A. rupestris*.

10. Dorsal anchor.—11. Ventral Anchor.—12. Cirrus and Accessory piece.—13. Hook.—14. Vagina.—15. Ventral.—16. Dorsal bars.

Cleidodiscus alatus, from *A. rupestris*.

17. Cirrus and accessory piece.—18, 19. Vagina.—20. Dorsal.—21. Ventral bar.—22. Hook.—23. Dorsal.—24. Ventral anchors.

Cleidodiscus brachus, from *Marg. margarita*

25. Cirrus and accessory piece.—26. Hook.—27. Dorsal.—28. ventral anchors.—30. Ventral bar.—31. Egg.

PLATE 3

Cleidodiscus malleus, from *Percina caprodes*.

1. Ventral, 2—dorsal anchors.—3. Cirrus and accessory piece.—4. Ventral, 5—dorsal bar.—6. Hook.

Dactylogyrus cornutus, from *Notropis cornutus*.

7. Cirrus and accessory piece.—8. Hook.—9. Anchor.—10. Dorsal bar, 11—ventral bar.—12. Vagina.

Dactylogyrus orchis from *Not. rubellus*.

13. Cirrus and accessory piece.—14. Dorsal bar.—15. Ventral bar.—16. Anchor.—17. Hook.

Dactylogyrus perlus from *Not. cornutus*

18. Anchor.—19. Cirrus and accessory piece.—20. Dorsal bar.—21. Ventral bar.—22. Hook (lower) and cuticular lip of vagina (upper).

Dactylogyrus bulbus from *Not. cornutus*.

23. Cirrus and accessory piece.—24. Dorsal bar.—25. Ventral bar.—26. Anchor.—27. Hook.

Dactylogyrus amblops from *Hybopsis amblops*.

28. Anchor (left) and cuticular lip of vagina (right).—29, 30, 31. Cirrus and accessory piece in different specimens.—32. Dorsal bar.—33. Ventral bar.—34. Hook.

PLATE 4

Dactylogyrus confusus from *Clinostomus elongatus*

1. Cirrus and accessory piece.—2. Anchor.—3. Dorsal, 4. ventral bar.—5. Hook.

Dactylogyrus acus from *Campostoma anomalum*

6. Cirrus and accessory piece.—7. Hook.—8. Dorsal.—9. ventral bar.—10. Anchor.

Dactylogyrus microphallus from *Sem. atromaculatus*.

11. Anchor.—12. Cirrus and accessory piece.—13. Hook.—14. Dorsal bar.

Dactylogyrus apos from *Hypentelium nigricans*

15. Anchor.—16, 17. Vagina.—18. Hook.—19. Dorsal.—20. ventral bar.—21. Accessory piece.—22. Cirrus.—23, 24. Cirrus and accessory piece in different worms.

Dactylogyrus tenax from *Sem. atromaculatus*.

25. Hook.—26. Dorsal bar.—27. Anchor.—28. Cirrus and accessory piece.

Dactylogyrus photogenis from *Not. photogenis*.

29. Cirrus and accessory piece.—30. Dorsal.—31. ventral bar.—32. Hook.—33. Anchor.

PLATE 5

Dactylogyrus urus from *Moxostoma anisurum*.

1. Dorsal bar.—2. Cirrus and accessory piece.—3. vagina.—4. Hook.—5. Anchor (left) and ventral bar (right).

Dactylogyrus rubellus from *Not. rubellus*.

6. Cirrus and accessory piece.—7. Hook.—8, 9. Dorsal.—10. ventral bar.—11. Vagina.—12. Anchor.

Dactylogyrus scutatus from *Exoglossum maxillingua*.

13, 14.—Dorsal bar in different worms.—15. Ventral bar and 4 hooks associated with it which lie on an elevated portion of the haptor.—16. Anchor.—17. Cirrus and accessory piece.

Dactylogyrus duquesni from *Moxostoma duquesni*.

18. Anchor.—19, 20.—Hooks.—21. Dorsal.—22. ventral bars.—23. Vagina.—24, 25. Cirrus and accessory piece.

Dactylogyrus fulcrum from *Not. cornutus*.

26, 27. Cirrus and accessory piece.—28. Accessory piece.—29. Hook.—30. Dorsal.—31. Ventral bar.—32. Anchor.

PLATE I

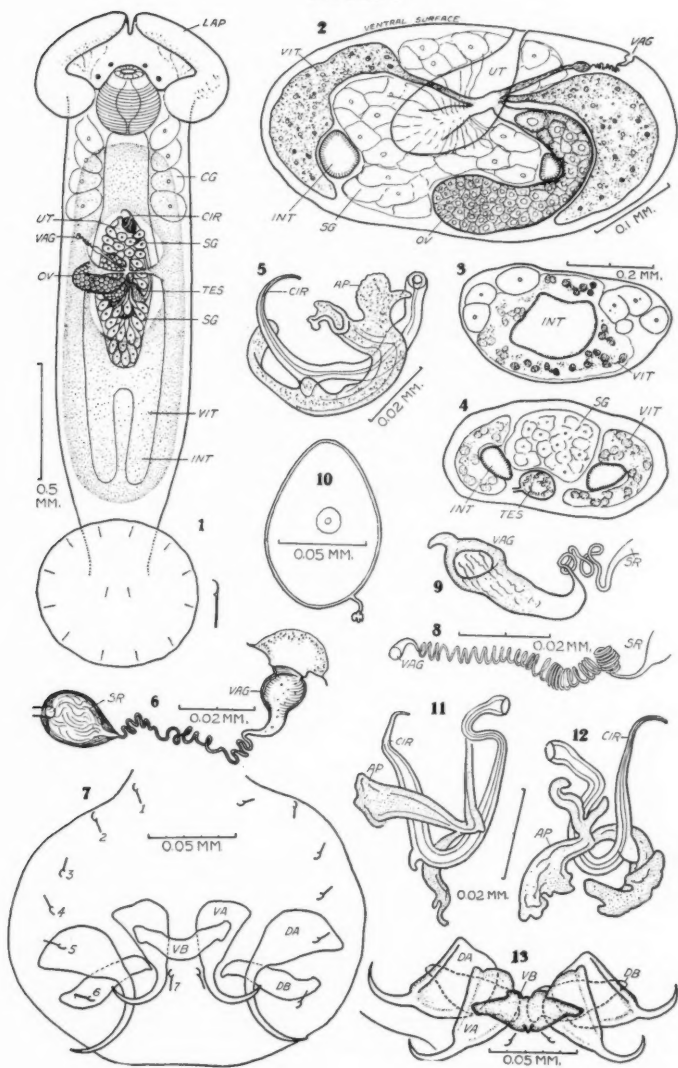


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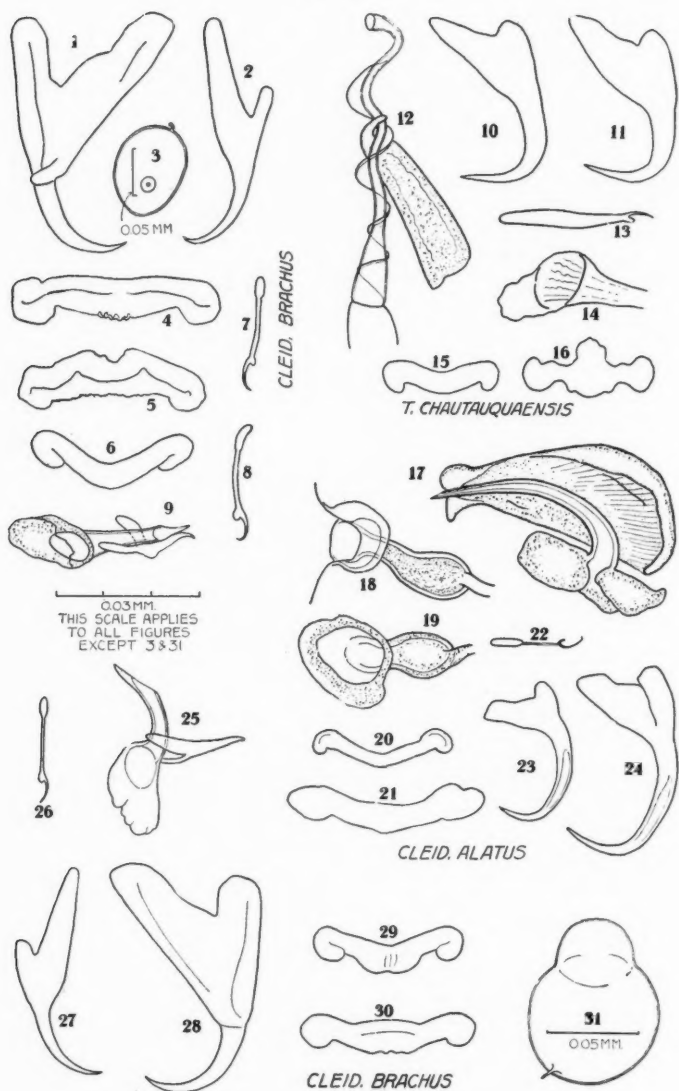


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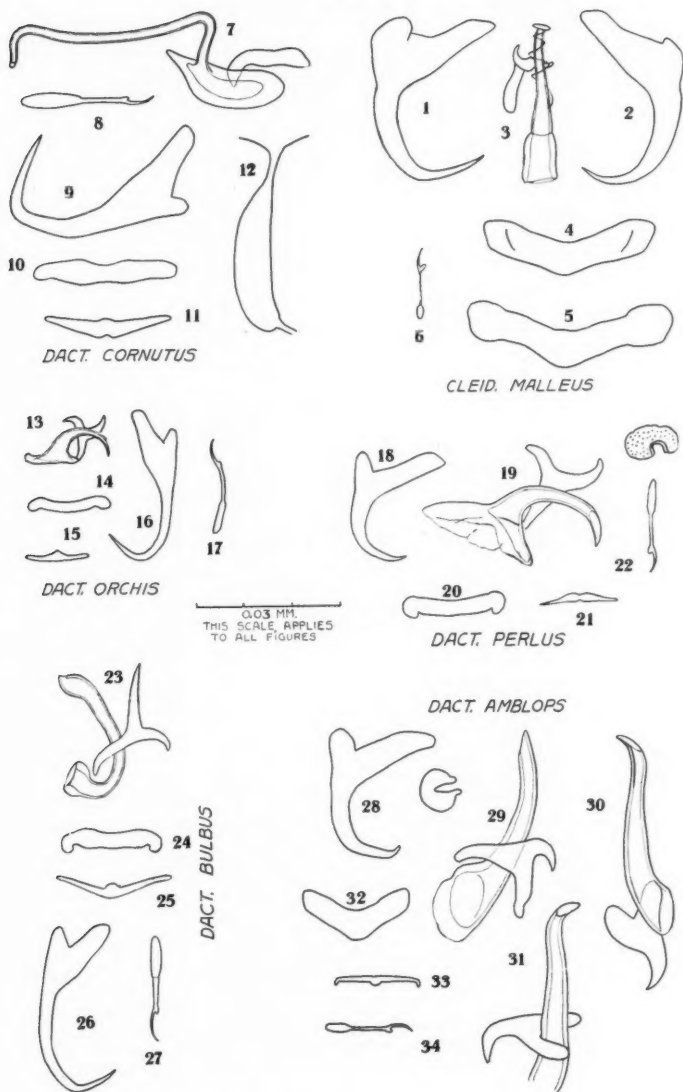


PLATE 4

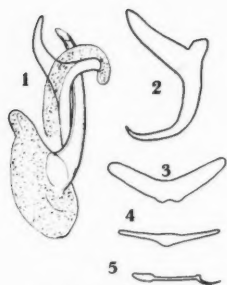
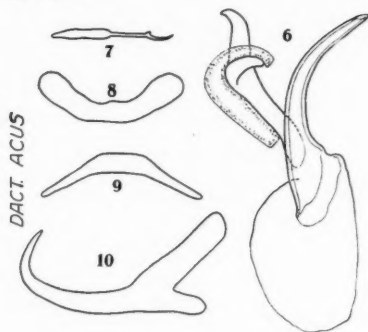
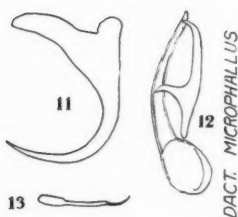
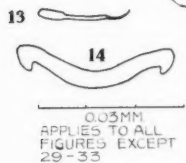
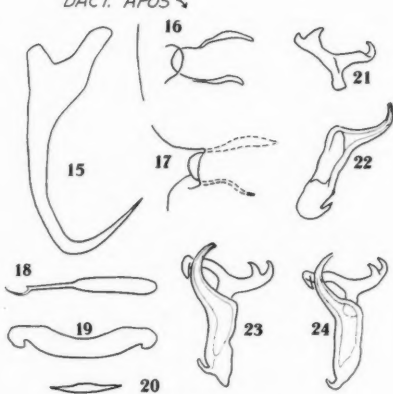
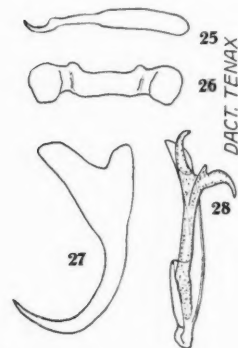
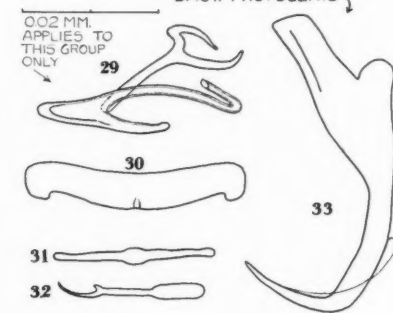
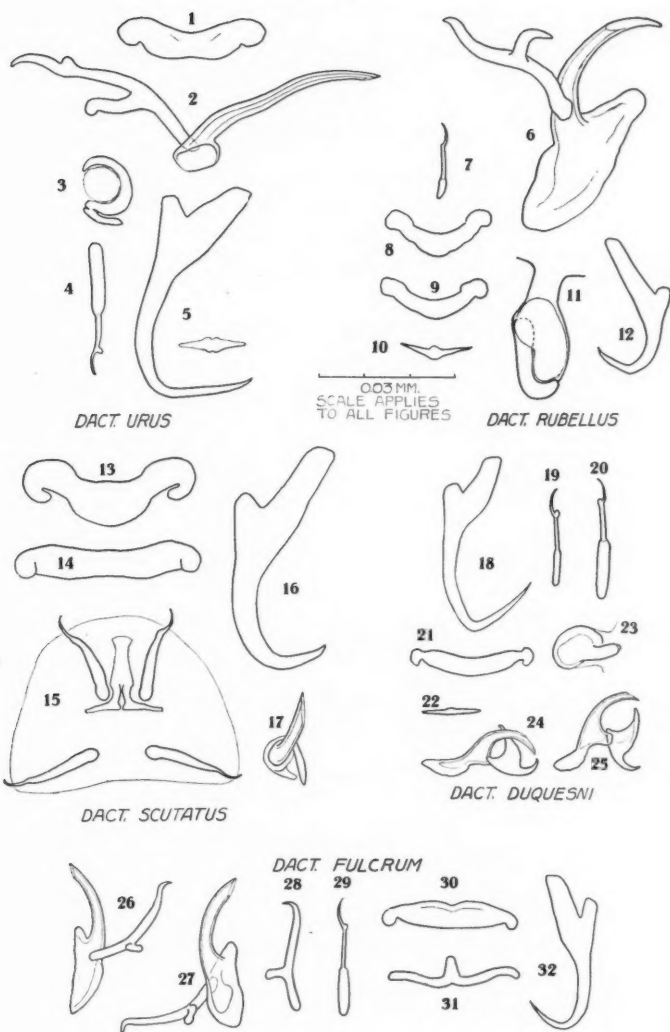
*DACT. CONFUSUS**DACT. ACUS**DACT. MICROPHALLUS**DACT. APOS**DACT. PHOTOGENIS**DACT. TENAX*0.02 MM.
APPLIES TO
THIS GROUP
ONLY0.03 MM.
APPLIES TO ALL
FIGURES EXCEPT
29-33

PLATE 5



Suggestions Concerning Taxonomic Nomenclature of the Hymenopterous Family Formicidae, and Descriptions of three New Ants

A. C. Cole, Jr.

The writer is convinced that authors of descriptions of new ants who deal with categories less than species have very often violated our accepted rules of nomenclature. The status of a great many described kinds of ants is definitely insecure at present because of these inaccuracies. The purpose of this paper is an attempt to clarify these inconsistencies and to describe three new ants on the basis of a more scientific method.

From the standpoint of taxonomy, "if a group of closely similar individuals, or an individual which may represent such a group, is distinguished from another by one or more nonintergrading structural characters, it may be regarded as a species, unless and until it can be shown not to merit that distinction."¹ It happens that such species are seldom relegated to lower categories unless, of course, they are found to be synonymous with certain subspecies. More often, however, they lose their distinction by becoming merely synonyms of previously indicated species. This usually occurs because of the failure of the describer properly to examine, through neglect or carelessness, authentic representatives of the already described members of the genus.

If a group of closely similar individuals, or a representative of that group, is geographically or ecologically isolated from a species and possesses characters which separate it from the species, but with which it intergrades, it may be considered as a subspecies. Thus it becomes necessary to recognize both geographic and ecologic subspecies. Ecologic subspecies are probably more numerous in the Formicidae than one might suppose. Some botanists have used the term "ecotype"² to indicate a habitat type for plants. Turesson proposed the term "ecospecies"³ to define Linnaean species or genotype compounds as they are found in Nature. The ecotypes are the ecologic units of Turesson's ecospecies. Naturally, a great range of combinations of characters is possible within an ecospecies. Thus an ecologic subspecies of an ant, for example, is comparable to an ecotype, in that it is an ecologically isolated unit. McAtee⁴ indicates that it may become necessary to recognize both geographic and ecologic subspecies.

1 Ferris, G. F., *The Principles of Systematic Entomology*, Stanford Univ. Press, 1928; p. 57.

2 Barton-Wright, E. C., *Recent Advances in Botany*, J. & A. Churchill, London, 1932; p. 86.

3 *Hereditas*, IX, (1927).

4 McAtee, W. L., *Ent. News*, XXXI, (1920), p. 53.

The term "variety" has been subjected to considerable abuse in myrmecological literature. Many workers have classed as varieties those forms which vary from the typical one in size, in color or in a combination of these. Ant literature is replete with descriptions of varieties of both species and subspecies. The advisability of assigning varietal rank to any kind of ant is very questionable, especially when we consider our loose interpretation of the term. The only excuse, as I see it, of a varietal status for ants is that it affords us a category in which to put color variants. As McAtee⁵ contends, we shall sooner be able to determine what color varieties are if named rather than unnamed. I can see no desirability whatever of recognizing varieties of subspecies of ants, in spite of the fact that this has been done extensively. Since a subspecies is an ecologically or geographically isolated unit which intergrades with the typical species, its variants as such would have to intergrade with the species and would furthermore be isolated within the ecologic or geographic boundaries of it. Since this so-called variety would necessarily intergrade also with the species *sensu stricto*, and since it would, of course, be ecologically or geographically isolated from it, it should, I believe, be actually relegated to subspecies rank.

Too often the varietal status is given to a clearly recognizable form which should undoubtedly belong in a higher category. For example, a recently described ant, *Pogonomyrmex occidentalis* var. *utahensis* Olsen⁶ was given varietal rank as shown here. Four distinct characteristics separate the worker from the typical species; all pertain to structure. In other respects it is apparently identical to the typical species. Yet these different structural characters could actually place it in the species category. Furthermore, the type locality for *utahensis* is Zion National Park, Utah. While the elevation of the habitat or any information concerning the habitat is entirely omitted in the published paper, it is possible that *utahensis* may actually be a subspecies because of ecological isolation. I made collections of ants in the Park during the summer of 1931, and among these I have series of workers from four nests of what is now *utahensis*. The ants were taken from small pebble-mound nests in a deep ravine. Elsewhere in the Park I found nests of the typical *occidentalis*. Although evidence in this case is far from conclusive, there is a distinct possibility that factors of ecologic isolation reacted to produce by selection what may actually be a true subspecies. Hence, there is a possible choice in the case of *utahensis* of elevating it to the rank of subspecies or of species. Obviously, it remains in too low a category.

It is refreshing to see a recently published paper on new species of ants which exemplifies thoroughness in description and accuracy in nomenclature.⁷ In this article the ants—all of the genus *Formica*—are given specific rank in each case because they possess the required one or more nonintergrading structural characters. There is little doubt that some myrmecologists would quite erroneously have given these ants only subspecific rank.

⁵ McAtee, *ibid.*

⁶ Olsen, O. W., *Bull. Mus. Comp. Zool.*, LXXVII, (1934), p. 509.

⁷ Kennedy, C. H. & C. A. Dennis, *Ann. Ent. Soc. Amer.*, XXX, (1937), pp. 531-544.

It is apparent that in order to prevent the classification of Formicidae from attaining a more chaotic condition, the rules of nomenclature must be followed more conscientiously. The rather vague and unsatisfactory methods of the past need to be discarded and replaced by thoroughly scientific procedure.

Leptothorax tennesseensis sp. nov.

Holotype, worker (Cole collection No. C-T-2068). (Fig. 1).

Total length, 2.8 mm. (Paratypes, 2.8-3.0 mm.).

Head subrectangular, excluding mandibles slightly longer than broad; posterior border slightly concave; posterior angles rounded; sides subparallel. Eyes ovoid and convex. Mandibles rather broad, curved, overlapping, 4-toothed; apical tooth long, rather sharp; second tooth half as long as apical tooth, more blunt; third tooth short, blunt; fourth tooth longer than third, about half as long as second, sharper, more slender; basal teeth minute. Clypeus moderately convex, broadly rounded in front, anterior margin deeply and broadly excised; without a median longitudinal carina. Frontal area present. Antennae 12-segmented; scape extending one-fourth its length beyond posterior angles of head; first funicular joint shorter than the three succeeding joints taken together; club 3-jointed, apical joint longer than the two basal joints which are subequal.



Fig. 1. Lateral view of the thorax of *Leptothorax tennesseensis* n. sp., showing contours.

Thorax robust; pro- and mesonotum convex; mesoepinotal constriction deep and broad; neck rather long; cervical declivity of pronotum not sharp. Epinotal spines moderately short, less than the distance between their bases which is exactly equal to the width of the petiolar node; rather sharp; directed upward and only slightly backward. Legs robust with incrassated femora. Petiole, viewed in lateral profile, with rather low convex node, its apical border truncate; anterior slope long, posterior slope shorter and more abrupt; somewhat flattened; ventral surface of peduncle without a tooth. Postpetiole much larger than petiole, broader but not higher; dorsal surface in profile very convex; broader than long. Gaster oval, much narrower than head, subtruncate at base.

Mandibles finely and longitudinally striated. Clypeus shining, very finely and sparsely punctate. Head smooth and shining; very finely and sparsely punctate, especially on vertex. Antennal fovea with curved parallel rugae; frons and genae with straight rugae. Frontal area of head subopaque and delicately rugose. Pronotum and dorsum of mesonotum smooth and shining; anterior declivous surface of pronotum with a very few parallel transverse rugulae; pleurae of meso- and epinotum coarsely reticulate-rugose, very

coarsely and deeply punctate; mesoepinotal constriction, and dorsum of epinotum, coarsely and longitudinally rugose. Declivous surface and epinotum smooth and shining. Petiole and postpetiole shining and reticulate above, more opaque and reticulate-rugose on the sides. Gaster smooth and shining.

Hairs long, slender, pointed and very abundant; suberect on antennae and legs; erect elsewhere.

Thorax rich light tan; antennae, dorsum of head except mandibles, postpetiole and gaster much darker; mandibular teeth and tips of epinotal spines dark tan (color of head); apex of antennal club yellow.

The holotype was selected from a series of eight workers collected by the author where they were attending aphids on stems of *Senecio smalli* in an area of *Andropogon virginicus*, near Greenbriar Cove, Great Smoky Mountains National Park, Tennessee (Elev., 2000 ft.), May 15, 1937. Several hours of careful observation of *S. smalli*, which was in full bloom, netted only these eight specimens. They were found intermingled with numerous workers of *Monomorium minimum* Buckley. *L. tennesseensis* is a beautiful little ant whose pilosity, as revealed by a lens, makes it even more striking.

L. tennesseensis differs from *pergandei*, its closest relative, in the following respects: (1) It has only four prominent mandibular teeth; (2) the first funicular joint of the antennae is shorter than the three succeeding joints taken together; (3) the apical joint of the antennal club is longer than the two basal joints taken together; (4) the epinotal spines are longer; (5) the apical border of the petiolar node is truncate; (6) the ventral surface of the peduncle of the petiole does not bear a tooth; (7) the anterior declivous surface of the pronotum has a few delicate parallel rugae; and (8) the color of the body is lighter and the tips of the antennal club are yellow.

***Aphaenogaster texana punctithorax* subsp. nov.**

Holotype, worker. (Cole collection No. C-T-2186). (Fig. 2).

Total length, 3.8 mm. (Paratypes, 3.5-4.0 mm.).

Head very slender, including mandibles twice as long as broad, narrowed behind the eyes. Eyes large. Antennae long, their scapes extending one-third of their length beyond the posterior border of the head; without prominent lobe at base; joints of funiculi long and slender. Basal teeth of mandibles large and nearly the size of apical teeth. Epinotum long, its spines rather short, acute, directed upward and backward. Postpetiole large compared with petiole, its node rounded.



Fig. 2. Lateral view of the thorax of *Aphaenogaster texana* subsp. *punctithorax* n. subsp., showing contours and position of hairs.

Head and thorax subopaque and very densely and rather coarsely punctate; petiole and postpetiole sparsely and more finely punctate. Lateral surface of epinotum with several coarse parallel rugae. Clypeus subopaque, rough, somewhat rugose. Posterior corners of head, legs, declivous surface of epinotum and gaster smooth and shining.

Hairs sparse, erect, rather short, blunt, of almost uniform size; most dense on vertex of head, and on postpetiole and gaster; sparse on pronotum and especially on mesonotum; almost absent on epinotum except for a single pair on dorsum; absent on venter of thorax; longer, more pointed and slender on coxae and on gula and frons of head; very blunt on vertex of head; appressed on antennae.

Color, a rather uniform dark grayish brown under magnification, grayish black without magnification; legs and antennae dusky yellow; antennal scapes somewhat infuscated; hairs yellow.

The holotype was selected from a series of five workers taken by the writer from a minute surface nest beneath a rock on a wet, deciduous forested slope of Gregory's Bald (Elev., 3500 ft.), Great Smoky Mountains National Park, Tennessee, October 19, 1937. The queen could not be located. There were four small larvae in the single nest chamber. The habitat suggests distinct geographic isolation.

A. texana punctithorax differs from typical *texana* and from its described subspecies and varieties in the following respects: (1) Smaller size; (2) head and especially the thorax more coarsely punctate; (3) clypeus very rough and subopaque; (4) hairs much more sparse; and (5) color rather uniform dark grayish brown.

***Pogonomyrmex occidentalis owyhee* subsp. nov.**

Holotype, worker. (Cole collection No. 1004).

Total length, 5 mm. (Paratypes, 5.0-5.5 mm.).

Differs from the worker of *P. occidentalis* Cresson, which is a very common mound-building ant in the western United States, in its much smaller size (*occidentalis* varies between 7 and 10 mm.) and its paler color. Its color is a light yellowish tan, while the worker of the typical *occidentalis* is a claret brown.

Paratype, nest queen. (Cole collection No. 1004).

Total length, 8 mm.

Differs from the queen of the typical *occidentalis* as follows: Entire body, except pronotum, densely beset with robust, yellowish, erect and suberect straight hairs; blunt on thoracic dorsum, pointed elsewhere; longest and most numerous on petiole, postpetiole and gaster; shorter on head and thorax; sparse on prothorax. Epinotal spines shorter and more blunt. Head, antennae, legs and thorax tan; petiole, postpetiole and basal segment of gaster light brown; other segments of gaster deep brown.

The holotype was selected from a series of more than one hundred workers taken by the author from mound nests in pure sand in a sand dune area at Indian Cove, near Hammett, Idaho, September 30, 1931.

This ant is treated as a subspecies for the following reasons. The habitat of *owyheeii* is far different from that of the typical species. *Owyheeii* constructs its nests only in pure sand, where it makes small mounds with single central entrances. These nests were abundant at the type locality. Although large pebble mounds of the typical *occidentalis* were plentiful in the large *Artemisia tridentata* (sagebrush) area surrounding the dunes, none was found in sand. Like other members of the genus, *owyheeii* is primarily a harvester. Border of chaff were found near the nest openings. Such circles of chaff are very seldom found on or around mounds of the typical species.

Series of specimens were taken from dozens of nests of *owyheeii* in the dune area. All workers varied in length only within the limits ascribed above, and this consistency was maintained throughout specimens from all nests sampled in the dune area. This ant has also been collected from sand hills in Clear Lakes Canyon, near Buhl, Idaho. It is apparently restricted in distribution to hot, dry, sandy habitats. It has never been found on the sagebrush plains with *occidentalis*.

This probably represents a distinct case of ecologic (habitat) isolation. There is evidence that there has been a selection of characters favorable to the development and maintenance of *owyheeii*. This would tend to explain the small size of *owyheeii*, its pale color, its habitat and type of nest.

Type material of the ants described in this paper is in the author's collection.

DEPT. OF ENTOMOLOGY,
UNIVERSITY OF TENNESSEE,
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Adhaerentia, a New Foraminiferal Genus

Helen Jeanne Plummer

During a study of considerable material collected from Midway (lowest Eocene) outcrops in Alabama by Miss Winnie McGlamery of the Alabama Geological Survey, a very interesting large foraminifer has been found extensively in both the Clayton and Sucarnoochee formations of this group. In the large amount of Texas Midway material that has been studied during the past several years, this same form has been found at only one locality,¹ where it is very rare. Mr. M. L. Thompson, who has examined considerable outcrop material in Mississippi, reports that this same species is common in the strata of the Midway group of that state, and he has kindly furnished specimens for comparison. This species is offered as the genotype of the new genus *Adhaerentia*.

Genus *Adhaerentia*, gen. nov.

The unique feature of the adventitious and labyrinthic tests of this new genus is the adherence of the proloculum upon some host; the rest of the test is free. Following the proloculum the early chambers are compactly biserial; later chambers show a progressive loosening of the biserial arrangement into a uniserial succession of the final two or three chambers of fully mature tests. On the early chambers the aperture is simple and lies toward the apex of the test. With growth of the test, the single aperture becomes more and more irregular in outline until finally on mature chambers it is typically multiple and wholly terminal.

The adherence of the proloculum is probably an inheritance of a previously dominant character of the entire test. This feature together with the labyrinthic structure of the chambers suggest a position late in the evolution of the family Placopsilinidae.

Genotype, *Adhaerentia midwayensis*, n. sp.

Adhaerentia midwayensis, sp. nov.

Fig. 1

This large, very elongate, adventitious test is especially striking in the adherence of its hemiglobular proloculum on the side of a closely coiled hyaline form, such as *Cibicides*, *Anomalina*, *Lenticulina*, or other similar

¹ Basal clays of the Wills Point formation, upper unit of the Midway group in Texas, exposed in a creek bank 2 miles north-northwest of Mexia, Limestone County. This same outcrop furnished the figured specimens of *Coleites reticulosus* (Plummer) and *Epistominoides wilcoxensis* (Cushman and Ponton) used to illustrate the structure of these two genera in a previous paper by the present author. (Amer. Midl. Nat. 15: 601-608, pl. 24, 1934.)

member of the faunal assemblage. Usually the host chosen as an anchor is somewhat larger than the proloculum. From this initial position, growth of the test lies in the direction of the plane of coiling of the host, which therefore forms a keel at the initial extremity of the elongate structure. Most prolocula are so placed that about half the hyaline host is hidden by the early portion of the adherent test, and the lower edge of the second chamber lies on the opposite side of the host. Frequent tests of *Adhaerentia midwayensis*, n. sp., show the proloculum so close to the periphery of the hyaline coil, that the second chamber lies free. Since the apparent adherence of the second chamber is only incidental to the original position of the proloculum, only the proloculum can be regarded as inherently adherent. The arrangement of the first four or five tumid and gradually enlarging chambers is rather compactly biserial, and additional uncompressed chambers of approximately equal diameter become more and more loosely biserial, until very late chambers of exceptionally large tests are typically uniserial.

The sutures on the earliest portion of many tests are so indistinct that individual chambers are difficult or impossible to distinguish. For illustration tests showing clearly the early chambers have been chosen. Later sutures are likely to be distinct but shallow.

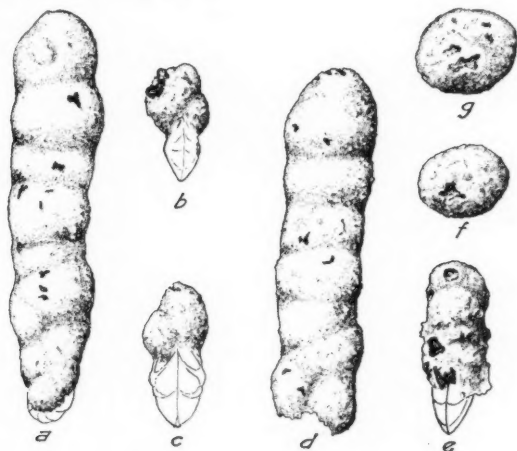


Fig. 1. *Adhaerentia midwayensis*, n. sp., x17. a, Holotype, showing essential features of a mature structure that has not quite attained uniseriality. b, c, Very young tests of two chambers each, showing relationships of host and earliest part of structure. d, Mature portion of a very large and exceptionally well-developed test showing two uniserial chambers; this complete test must have been almost 5 millimeters long. e, Apertural view of an unusually rough test showing the simple and rounded opening. f, Terminal view of an early chamber in the loosely biserial succession, showing its irregular outline. g, Terminal view of a late chamber in the loosely biserial succession, showing its multiple character. (Types in Plummer Collection, S-996 and S-997.)

The moderately rough to rather smoothly finished shell wall is composed largely of very minute mineral particles, many minute foraminiferal tests, and considerable cement. In this compact masonry flakes of mica, bits of brown bone material, grains of glauconite, and small shell fragments are frequent and usually deeply imbedded. This same shell character composes also the compact labyrinthic structure of the chambers.

The aperture of the early chambers is single and rounded to slightly lunar, and it lies toward the apex of the test on the septal face. As chambers are added, the opening becomes more and more irregular in outline and rapidly attains an almost terminal position on the elongate test. On very late chambers the aperture is truly multiple and consists of two or three irregular openings.

The maximum length of tests of *Adhaerentia midwayensis*, n. sp., is probably about 5 mm. The average length of the compactly biserial portion of the test is about 1.2 mm., though this measurement varies considerably. The average thickness of the mature chambers is about 0.8 mm. The diameter of the proloculum averages about 0.2 mm. The length of the holotype is 3.8 mm.; thickness of mature portion of test, 0.8 mm.; diameter of proloculum 0.3 mm.

The type locality for *Adhaerentia midwayensis*, n. sp., is an outcrop of Clayton formation (basal unit of the Midway group in Alabama) on a branch of Dixon Creek, bed of stream, on State Highway 96 about one mile south of the junction with Highway 28, sec. 1, T.13 N., R.6 E., Wilcox County, Alabama. This buff, micaceous, slightly glauconitic, somewhat fossiliferous, soft material rich in ostracods and foraminifera is associated with a limestone carrying many nautiloids, which will be described later by Dr. A. K. Miller.

The Skull of *Nannippus gratus* (Leidy) from the Lower Pliocene of Texas

C. Stuart Johnston

INTRODUCTION

The small horse skull described in this paper is part of a collection obtained for the West Texas State Teachers College from a quarry located on the Charley Rizzley Ranch, two miles Northeast of Goldston, Texas, in Donley County. This work was accomplished through the cooperation of the Works Progress Administration in 1936 under the supervision of Mr. Will Chamberlain.

DESCRIPTION OF MATERIAL

The skull of *Nannippus gratus* (Leidy), W. T. No. 639, Figs. 1-3. This is the most perfect skull thus far discovered in the Clarendon Beds representing the species *N. gratus*. It is not distorted and the only part of the skull that is missing is the anterior end of the premaxilla bearing the incisors, and the extremity of the supra-occipital bearing the lambdoidal crest. The teeth are badly worn, so much so that no enamel pattern can be seen on P⁴, M¹, and M². On the other teeth, however, the pattern is clear and distinct. At the posterior end of the nasals there is a small area which is slightly crushed, but which does not effect the remainder of the skull.

In the Clarendon fauna the family Equidae is predominant. Numerous skeletal elements are known representing a number of species and genera. Literally thousands of teeth and parts of skulls have been collected from a number of localities. Of these the *N. gratus* is perhaps the most typical, and the most abundantly represented of the Lower Pliocene Equidae of Texas. It is with a view, therefore, of supplementing our data that the following discussion on this species is presented.

GEOLOGY OF THE BEDS

The character of the sediments at the locality from which the above mentioned specimen was obtained is typical of the Clarendon Beds. Gray, somewhat calcareous clay predominates. This is of such a texture and so interbedded in some instances with coarse sand as to suggest that it may have been a flood-plain deposit. Indeed most of the Tertiary deposits of the High Plains as pointed out by Gidley (1903) are of this type. Many of the specimens collected are incased in hard calcitic concretions. The horse skull was preserved in the same manner, but in this instance there was an additional deposit of hematite which rendered the specimen very difficult to prepare. Most of the fossils are fragmentary, and some of them show evidence of having been water-worn.

CRANIOMETRY

Zygomatic Breadth	120 mm.
Orbital Breadth	70
Width of skull opposite M3	114
Width of palate opposite posterior margin of M1	32
Length of dental series P2-M3	88
Width of postpalatal notch	26
Depth of postpalatal notch	28
Length of orbit	38
Width of orbit	33
Distance from line opposite orbits to intersection of temporal impression	45
Breadth of zygomatic arch	11
Width of cranium	70
Length of nasals	98
Width of foramen magnum	19
Length of temporal impressions from origin to point of intersection	56
Width across occipital condyles	37

DENTAL MEASUREMENTS

	P2	P3	P4	M1	M2	M3
Anteroposterior diameter	15.5	14	12	13	12	15.5 mm.
Transverse diameter	14	17	17	17	16	15.5

RELATIONSHIPS

The type of *N. gratus* was originally described by Leidy in 1869 from the Loup Fork of South Dakota as *Hipparion gratum*, and is represented by several upper premolars and molars. Gidley (1907) refers this species to the genus *Neohipparion*. The subgenus *Nannippus* was proposed to include this group of Pliocene Equidae by Matthew (1926), typified by *Hipparion* (*Nannippus*) *phlegon* Hay, (*Equus minutus* Cope). Subsequent authors, Stirton (1936) and Hesse (1936) have given *Nannippus* generic distinction. The Clarendon specimens were compared to casts of the type specimen in the California Museum of Vertebrate Paleontology with which they agreed in every detail. In the unworn teeth of this species the inner border of the cement lakes are moderately complex. The hypoconal groove makes a rather sharp fold, but does not extend to the base of the tooth. There is a slight transverse curvature, and the meso- and meta-styles are somewhat rounded. The protocone tends to be elliptical in shape and is not connected to the protocone except in teeth that are considerably worn.

Nannippus gratus differs from *N. lenticularis* of the Texas Middle Pliocene as described by Matthew and Stirton (1930) in that in the latter form the teeth are somewhat smaller, and tend to be more hypsodont, the enamel borders more highly folded, the hypoconal groove extends nearly to the base of the tooth, the protocone is lenticular in shape and separate from the protocone even in old individuals. It appears, as Matthew and Stirton (Op. cit.) have pointed out that *N. gratus* stands as an ancestral type to *N. lenticularis* which in turn phylogenetically precedes the Upper Pliocene *N. phlegon*. The *N. phlegon* appears to have carried on the evolutionary tendencies of the two preceding species but did not survive the Pliocene.



Fig. 1.



Fig. 2.

Figs. 1 and 2, dorsal and lateral views of *Nannippus gratus* (Leidy), x.41.
W. T. No. 639.

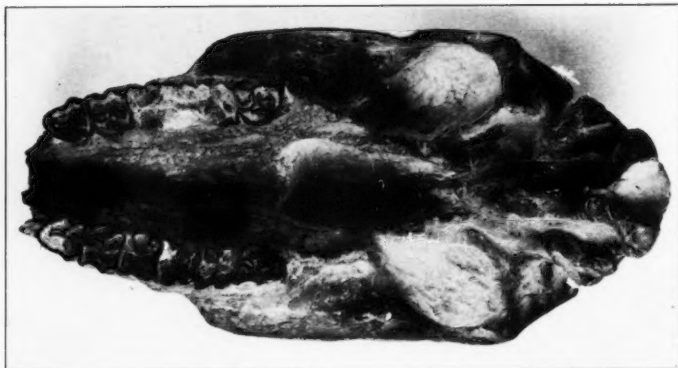


Fig. 3. Palatal view of *Nannippus gratus* (Leidy), x41. W. T. No. 639.

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A Revision of the Genus *Douglasia* Lindl.

Lincoln Constance

The Primulaceous genus *Douglasia*, comprising a small group of arctic and alpine rosette plants, is placed in subtribe *Androsaceae-Primulinae*, tribe *Androsaceae*, by Knuth (1905), who points out that generic distinctions are strikingly feeble in this branch of the family. *Douglasia* appears to be related to both *Primula* and to the perennial sections of *Androsace*, and certain of the species treated here have appeared under one or both of these generic names.

Specimens collected by David Douglas in the Canadian Rockies, near the sources of the Columbia, *Douglasia nivalis*, were the basis for the founding of the genus by Lindley in 1827. Hooker added *D. arctica* in 1838, from plants collected on the arctic seashore by Richardson. Asa Gray described *D. montana* from the Rocky Mountains and *D. laevigata* from Mount Hood and the Columbia Gorge. The genus *Gregoria* was subordinated to *Douglasia* by Benthams and Hooker (1873), and *D. Vitaliana* of the Alps and Pyrenees thus was placed with the American plants. Finally, Watson described *D. dentata* from the Wenatchee Mountains of Washington, Aven Nelson added *D. biflora* from the Wyoming Big Horn Range and Blankinship appended an herbarium name to Montana collections which he distributed widely.

Only two important treatments have been offered, that by Gray (1886) and that by R. Knuth (1905). Knuth has emphasized the differences in corollar morphology between his sections *Eudouglasia* and *Gregoria*, and it was with the hope of adducing additional floral characters for species definition that this study was originally undertaken. A considerable series of gelatine mounts of representative specimens of each named segregate not only failed to reveal additional characters, but showed the floral envelopes to be so stereotyped that all of Knuth's alleged distinctions, save only color, break down.

The most striking feature of the distribution of the species of *Douglasia* is their rather isolated occurrence and the wide gaps which separate most of them. Probably all may be classed as endemics of wider or narrower range. Habitat preference appears to be rather uniform, most of the species occupying rock crevices and talus slopes in arctic or subarctic situations where they are exposed to great extremes of illumination, insolation and evaporation. The rosette habit with the elongated tap root and the pubescence suggest the morphological effects of these operative influences. Two species are arctic or subarctic North American (possibly occurring also in Siberia), three occupy clearly distinct regions in the higher Western Cordilleras and the sixth is an indigene of the European Alps and Pyrenees. Such a discontinuous occurrence would seem to indicate a southward migration along several lines

from a subarctic American or holarctic center, with extinction of the connecting stations and rather complete isolation of the species. From the limited amount of recorded observations, *Douglasia* appears to occur upon both glaciated and unglaciated areas, but its status as a preglacial relict type appears to the author to be most plausible.

To postulate phylogenetic relationships solely upon brief taxonomic experience with a small group of species is admittedly rash, but the writer feels that any monographic study is barren unless some attempt is made to draw such an evolutionary summary. The presence of vestiges of stellate pubescence in all species seems to indicate that this type of indumentum is a primitive characteristic. Two species are involucrate and three others habitually or occasionally develop a bract under the calyx, which would appear to be a remnant of this structure, suggesting that the monanthous habit is derived from the umbellate. The present range of the several species points to an arctic or subarctic North American origin for the group, from which *Douglasia Vitaliana* was an early emigrant.

The only living species (we have no record of any extinct ones) to possess both stellate pubescence and umbellate inflorescence is *Douglasia nivalis*, known to occur in the Canadian Rockies and possibly also much farther to the north. Starting with this species, it is easy to imagine *D. Vitaliana*, with its similar pubescence, to have become separated and migrated southeastward, adopting a monanthous condition and changing flower-color. The umbellate *D. laevigata* had only to change pubescence and alter leaf-form and to enter and occupy its present range. The remaining and closely related species, *D. arctica*, *D. Gormanii* and *D. montana*, reduced the umbel to a single flower subtended by a minute bract and abandoned in varying degree the primitive pubescence. *D. montana* var. *biflora*, which usually has two flowers with one to several bracts, shows a possible intermediate stage in inflorescence, and the occurrence of forked and simple hairs together on the leaves of *D. Gormanii* offers a suggestion of a possible transition for the fundamental change in pubescence.

The present treatment differs little in specific concept from those in other revisions previously proposed and commonly used. The kind of pubescence and the type of inflorescence, focused upon a back-drop of geographical distribution have been the chief criteria used for delimitation of taxonomic units in this study. Although each species manifests considerable variability in habit, leaf-form, pubescence and in size and number of structures, the boundaries seem to be clear-cut excepting within the last group of three closely related units.

The writer is happy to acknowledge his appreciation to the curators of the following herbaria for their generosity in lending material: Academy of Natural Sciences of Philadelphia (ANSP), Provincial Museum of Natural History, Victoria (BC), California Academy of Sciences (CAS), Gray Herbarium, Harvard University (G), Royal Botanic Gardens, Kew (K), Missouri Botanical Garden (M), Montana State College (MS), National Museum of Canada (NMC), New York Botanical Garden (NY), Oregon

State College (OSC), Rocky Mountain Herbarium, University of Wyoming (RM), Dudley Herbarium, Stanford University (S), University of California (UC), University of Oregon (UO), United States National Herbarium (US), University of Washington (UW), Willamette University (WILL) and State College of Washington (WSC). Mr. J. William Thompson (TH), of Seattle, has kindly permitted the examination of his excellent collections of the genus, and Mr. Reed C. Rollins has been of great assistance by checking bibliography at the Gray Herbarium.

DOUGLASIA Lindley

Vitaliana Sesler; Donati, Auszug Natur-Geschichte d. Adriat. Meeres, p. 75, t. 10. 1750. *Douglasia* Lindley; Brande Quart. Journ Sci., 385. 1827, nom. gen. conserv. proposit. Not *Douglasia* Adanson, 1763, nor Schreber, 1791. *Gregoria* Duby, Bot. Gall., 383. 1828. *Macrotybus* Dulac, Fl. Hautes-Pyr., 425. 1867.

Low caespitose perennials, *hemicyptophyta rosulata* or cushion-plants, suffrutescent at base and successively dichotomously branched from a tap root, branches prostrate, ascending or erect (apparently rooting from the nodes in some specimens of *D. laevigata*, *D. montana*, *D. nivalis* and *D. Vitaliana*), bearing terminal floriferous rosettes of imbricated leaves, these withering-persistent on the branches, the whorls remaining confluent or becoming more or less remote in age; branches proliferating from the terminal rosettes by slender, alternate-leaved shoots; peduncles, pedicels, involucre and calyces evanescently or permanently canescent with minute forked or stellate hairs; leaves membranaceous, canescent with forked or stellate hairs or glabrous save for the regularly ciliolate margins, or succulent and entirely glabrous; flowers solitary or several on naked, bracteate, or involucre peduncles which arise alone or severally form each terminal rosette; calyces 5-angled, lobed to near the middle, the tube scarious at least in the sinuses, the 5 lobes foliaceous; corollas pink, rose or violet (yellow in *D. Vitaliana*), funnellform, conspicuously coarctate at the throat and 5-fornicate within, the 5 lobes cuneate or obovate, entire or erose; style solitary, variable in length, bearing a small capitate stigma; anthers 5, oval or oblong, attached median dorsally in the upper 1/3 or 1/4 of the tube by very short filaments (apparently sessile in *D. Vitaliana*); ovary 1-celled with a cylindrical free placenta bearing 10-30 ovules; capsule subglobose, barely exceeding calyx-tube, dehiscing longitudinally from apex to base by 5 valves, abortively 2- or 3-seeded; seeds oval to orbicular, plano-convex or ventrally concave, 2-3 mm. long, dark brown, finely pitted. Type species, *D. nivalis* Lindl. Rather narrowly endemic plants of the arctic coast of North America (and Siberia?) and the mountains of North Temperate Europe and America.

KEY TO THE SPECIES AND VARIETIES

Flowers 3-7, involucre in umbels.

Leaves stellate-pubescent; east side of Cascadian axis. -----1. *nivalis*

Leaves devoid of stellate pubescence; west side of Cascadian axis.

Leaves glabrous, narrowly lanceolate, fleshy. -----2. *laevigata*

Leaves ciliolate, lanceolate to spatulate, thin. -----2a. var. *ciliolata*

Flowers solitary or in pairs, with or without one or more subtending bracts.

Corollas yellow; flowers ebracteate; European. -----3. *Vitaliana*

Corollas red to violet; flowers usually bracteate; North American.

Flowers 2, on unequal pedicels -----4a. var. *biflora*

Flowers solitary or if in pairs the pedicels essentially equal.

Leaves glabrous dorsally, ciliolate on the margins.

Leaves linear, broadest at base; Rocky Mountains -----4. *montana*

Leaves oblanceolate, broadest distally; Arctic -----6. *arctica*

Leaves dorsally pubescent with forked or simple hairs, margins not definitely ciliolate; Arctic -----5. *Gormannii*

1. DOUGLASIA NIVALIS Lindl. in Brande Quart. Journ. Sci., 385. 1827.

D. dentata Wats., Proc. Amer. Acad. 17: 375. 1882. *D. nivalis* var. *dentata* Gray, Synop. Fl. 2/1: 399. 1886. *Androsace Dieckeana* Hausskn., Mitt. Bot. Ver. Gesamt-Thüringen, 22. 1890. *Primula Douglasii* Kuntze, Rev. Gen. 1: 400. 1891. *P. Douglasii* var. *dentata* Derganc; Kneucker, Allg. Bot. Zeitschr. 10: 111. 1904. *Douglasia Dieckeana* Knuth, in sched. *Gregoria nivalis* House, N. Y. State Museum Bull., nos. 233-234: 68. 1921.

Laxly caespitose, 3-15 cm. high, from a stout tap root; leaf-whorls becoming remote and the leaves reflexed in age; leaves, peduncles, pedicels, involucre and calyces more or less densely and permanently stellate-canescens; leaves linear-oblong, oblanceolate or spatulate, 5-15 or 18 mm. long by 1.5-4 or 5 mm. wide, obtuse, margin entire to sharply serrate, especially distally; peduncles 0.5-5 cm. high, bearing an involucre of 3-10 lanceolate, ovate-lanceolate or ovate, usually acute bracts, subtending an umbel of 2-7 or 10 rose-violet flowers; pedicels 1-10 (rarely 20) mm. long; calyx turbinate-campanulate, 4 mm. long by 3-4 mm. broad at summit, lobes lanceolate or ovate-lanceolate, acute, 3 mm. long, usually equalling or surpassing corolla-tube; corolla-tube 5.5 mm. long, lobes obovate, 5 mm. long, entire or erose; filament 0.5 mm. long, attached in upper 1/4 of tube.

Type: "On the Rocky Mts., near the sources of the River Columbia," Alberta, Canada, 1827, *Douglas* (G.K: isotypes). *Douglas'* Journal reveals that he, on Wednesday, May 2, 1827, crossed the crest of the Rocky Mountains at "The Committee's Punchbowl," between Mounts Brown and Hooker (which he had named). At that time he was near the proper latitude and longitude and it seems likely that the type was collected in that vicinity, although no subsequent collections have been made in the area.

Range: Wenatchee Mountains, northeastern Washington, and Rocky Mountains of Alberta and British Columbia; at an elevation of 2,500-7,000 feet; Hudsonian Life Zone.

WASHINGTON. County undet.: Wenatchee region, 1883, *Brandegee* 952 (ANSP.-G,UC,US); Yakima Region, 1882, *Brandegee* (G,M,UC.), *Tweedy* (NY,S); Cascade Mts., 1889, *Vasey* 469 (G,US,WSC). Ferry Co.: Bridge Cr.—Stranger Creek Pass, 1926, *St. John, Jones, English & Pease* 4025 (NMC,UC,WSC). Okanogan Co.: Fort Okanogan, *Wilkes Exped.* 1016 (US). Chelan Co.: Peshastin Cañon, 1880, *Watson* 264 (G: type of *D. dentata*); Peshastin, 1893, *Sandberg & Leiberg* (UC); Mt. Stuart, 1893, *Sandberg & Leiberg* 545 (UO,US,WSC); mountains, Wenatchee, 1896, *Whited* 116 (US,WSC); Tumwater (Lookout) Mt., 1931, *Thompson* 6505 (ANSP,G,M,OSC,S,TH); Chumstick Mt., 1932, *Thompson* 8507 (G,M,-

NY,S,TH,UC); Ice Lakes, 1933, *Morrill* 316 (UW); First Creek, 1936, *Edwards* 218 (WSC). Kittitas Co.: Yakima River, Clealum, 1892, *Henderson* 2365 (G,UW); Teanaway Creek, 1898, *Whited* 778 (G,OSC,US); Mt. Stuart, 1898, *Elmer* 1230 (M,WSC), 1898, 1233 (US); Beverly Creek, 1930, *Thompson* 5869 (ANSP,G,M,S,TH), 1931, 6389 (G,M,NY,OSC,S,TH,US), 1933, 9490 (CAS,M,NY,S,TH,UC,US); Iron Mt., 1931, *Thompson* 6639 (ANSP,G,M,NY,OSC,TH,US); Liberty, 1935 *Thompson* 11,445 (ANSP,CAS,MS,NY,TH,UW,WSC). Douglas Co.: Pine Canyon, 1934, *S. Anderson* 77 (UW).

This unit has long passed under the name of *D. dentata* Wats., which was based upon plants of grosser habit and broader, serrate leaves than the type of *D. nivalis*, but there is no other distinguishing character. *Thompson* 6505 and 9490, and *Henderson* 2365 embrace both leaf-types in each collection, so it seems evident that this alleged distinction is merely a leaf variation without either correlated characters or geographical significance. Watson's type bears upon it, in Asa Gray's handwriting, "*= D. nivalis*," but this opinion was never published, although Gray did reduce *D. dentata* to varietal rank under *D. nivalis*.

2. DOUGLASIA LAEVIGATA Gray, Proc. Amer. Acad. 16: 105. 1880.

Primula laevigata Derganc; Kneucker, Allg. Bot. Zeitschr. 10: 111. 1904. *Gregoria laevigata* House, N. Y. State Museum Bull., nos. 233-234: 69. 1921.

Laxly caespitose or depressed, 2-10 cm. high, from a slender tap root; leaf-whorls becoming more or less remote with age, depending upon rate of growth of the individual plant; peduncles, pedicels, involucre and calyces stellate-glabrate; leaves oblong, oblanceolate or spatulate, 5-15 mm. long by 2-6 mm. wide, mostly obtuse, margins entire or the larger leaves with 3-7 apical teeth, either succulent and glabrous or thin, membranaceous and regularly ciliolate, especially toward the base; peduncles 2-5 or 7 cm. high, bearing an involucre of 3-7 lanceolate or ovate, acute or obtuse bracts subtending an umbel of 2-6 rose-pink flowers; pedicels 2-7 or 8 mm. long, varying greatly in length in the same umbel; calyx broadly campanulate, tube scarious in the sinuses, 4 mm. high by 4 mm. wide at summit, lobes linear- or ovate-lanceolate, mostly acute, 3 mm. long, shorter than or equalling corolla-tube; corolla-tube slightly coarctate, 6-6.5 mm. long, lobes obovate, often erose; filaments 0.6 mm. long, attached in upper 1/4 of tube.

Type: "Mountains near Mount Hood," Oregon, 1884, *Joseph* and *Thomas J. Howell* (G: type).

Range: Mountains of southwestern Washington and adjacent Oregon at 5,000-7,000 feet altitude, but as low as 100 feet in the Columbia River Gorge; Humid Transition to Hudsonian Life Zone.

WASHINGTON. Skamania Co.: Wind Mt., 1932, *Thompson* 8147 (M,TH); Lower Cascades, 1886, *Suksdorf* (WSC); Mt. Hamilton, 1920, *Gorman* 4870 (ANSP,OSC,S). OREGON. Hood River Co.: Mitchell Point, *T. J. Howell* (NY,OSC,S,UC,UO), 1884, *Suksdorf* 387 (ANSP,G,M,NY,S,UC,UO,US,WSC), 1928, *Thompson* 4045 (M,NY,OSC,S,TH,US,WILL), 1936, *Constance, Rollins & Dillon* 1453 (BC,K,NMC,WSC); mountains, Cascades of the Columbia, 1886, *Howell* (G); mouth of Hood River, 1880, *Howell* (S,US); Hood River, 1882, *Mrs. Barrett* (C); Hood River, N. side of Mt. Hood, 1898, *Langville* 83 (US).

This species (as here characterized) is divisible into at least two geographical phases: (1) the plant found widely in the Olympic Mts., in the Mt. Rainier and Mt. Hood regions of the Cascades, and on Saddle Mountain of the Oregon Coast Ranges, and (2) the narrowly endemic form of the Columbia Gorge. The original description of *D. laevigata* was drawn from the latter variant, so this local phase is at once the nomenclatorial species and the biological variety of the Olympic plant, and the Olympic phase is the biological species, but must, nevertheless, be subordinated in naming. The "species" is composed of plants (cited above) usually depressed in habit, with narrow, succulent, glabrous, mostly entire leaves, smaller and fewer flowers, and often more slender peduncles and longer pedicels.

2a. *DOUGLASIA LAEVIGATA* Gray var. *ciliolata* var. nov.

A planta typica differt: foliis latioribus, regulariter ciliolatis, non succulentis; pedunculis longioribus; pedicellis brevioribus; floribus numerosis, maioribus.

Type: Moist rocky bluffs, near summit of Mt. Henderson, 8 miles north of Lake Cushman, Olympic Mountains, Mason County, Washington, 1890, *Henderson 3878* (UO: type; G,M,RM,S,UW,WSC: isotypes).

WASHINGTON. County undet.: Olympic Mts., 1889, *J. M. Grant* (G), 1890, *Piper 1062* (G,S,US,UW), 1898, *Flett 804* (US,WSC); Olympic Peninsula, 1929, *Maj. Nation* (BC). Pierce Co.: Goat Mts., 1895, *Allen 187* (G,M,NY,RM,S,UC,US,UW,WSC); Iron Mt., 1927, *F. A. Warren 577* (WSC), 1928, *863* (WSC). Snohomish Co.: Mt. Dickerman, 1932, *Thompson 8844* (M,TH). Mason Co.: N. Fk. Skokomish River, 1892, *Henderson 2366* (G,UW); Mt. Ellinor, 1912, *Foster 2196* (UO,WSC). Jefferson Co.: Mt. Steele, 1895, *Piper 2235* (G,NY,UO,US,WSC); Hoh Ridge, 1897, *Merriam* (US); Mt. Barnes, 1928, *Leach & Leach* (UO); Constance Ridge, 1931, *Thompson 6589* (ANSP,M,OSC,NY,TH), 1936, *F. G. Meyer 731* (WSC); Marmot Pass, 1931, *Thompson 7961* (ANSP,G,M,S,TH); Bogachiel Peak, 1934, *Murie 1150* (M); Mt. Duckabush, 1935, *Dickinson 59* (UW). Clallam Co.: Olympic Mts., 1900, *Elmer 2801* (M,S,TH,UO,US,WSC); Lake Crescent, 1904, *Lawrence 356* (UC,WSC); Happy Lake, 1921, *Taylor* (CAS); Hurricane Ridge, 1931, *C. N. Jones 3225* (MS,UW), 1934, *Thompson 10,588* (NY,S,TH); Boulder Creek, 1933, *Jones 8440* (UW); Seven Lakes Basin, 1935, *Jones 8324* (UW,WSC); Mt. Angeles, 1930, *Thompson 5609* (ANSP,G,M,S,TH), 1931, *7543* (G,M,NY,S,TH,UC), 1932, *8398* (ANSP,G,M,NY,RM,S,TH,UC), 1933, *9461* (G,NY,S,TH,UC,US), 1931, *J. T. Howell 7520* (CAS); Mt. Carrie, 1921, *St. John 5808* (UC,WSC). OREGON. Hood River Co.: 45th Par., Cascade Mts., 1895, *Lloyd* (NY). Clatsop Co.: Saddle Mt., 1924, *Neenan* (WILL).

The variety applies to the relatively widespread phase of the species which occupies its entire range, save for the Columbia Gorge and closely adjacent points. From the Columbia River plants it differs in being usually larger in all structures, with broader, usually toothed, thin leaves, which are regularly ciliolate, the peduncles are usually longer and stouter, the pedicels are shorter and less variable in length and the flowers are commonly larger and more numerous. English (1936), who has cultivated plants from the Olympics, states that these are stem-rooting, but this habit seems to occur widely throughout the genus, so that I am unable to say whether or not it constitutes an additional character for separation.

That this segregate is not of specific rank is indicated by the fact that intermediate states occur frequently even in the critical character of thickness and ciliation of the leaves. The type specimen of *D. laevigata*, indeed, shows some minute marginal hairs, and so is somewhat intermediate in these characters, itself, as are also the following collections: *Allen* 187, *Suksdorf* 387, *Thompson* 8844 and *Warren* 577 and 863. However, because the two phases manifest considerable stability in these characters, and because each is a fairly distinct geographical entity, recognizeably different in the field, this treatment seems to the writer to be most in accord with modern taxonomic practice.

3. DOUGLASIA VITALIANA (L.) Hooker f.; Benth. & Hook., Gen. Pl. 2: 632. 1873.

Primula Vitaliana Linnaeus, Spec. Pl. ed. 1, 143. 1753. *P. sedifolia* Salisbury. *Paradisus Londinensis* 2: t. 107. 1807. *Gregoria Vitaliana* Duby, Bot. Gall. 1: 383. 1828. *Androsace Vitaliana* Reichenbach & Reichenbach, Icon. Fl. Germ. 17: 51. 1855. *A. lutea* Lamarck, Fl. Franc. 2: 253. 1778. *Arelia Vitaliana* Loddige, Bot. Cabinet 2: t. 166. 1818. *Macrotibus luteus* Dulac, Flora Hautes-Pyr., 425. 1867. *Vitaliana primulaeflora* Caruel; Parlatores, Flora Italiana 8: 649. 1889.

More or less laxly caespitose, 2-10 cm. high, from a slender tap root; leaf-whorls becoming remote with age; alternate-leaved, proliferating shoots arising with the flowers; peduncles and calyces permanently stellate-canescens; leaves linear-oblong, 5-10 mm. long by 1.5-2 mm. wide, entire, sub-acute, permanently stellate-canescens at least toward the margins; peduncles 1-several, short and 1-flowered, 1-5 mm. high, from terminal rosettes, entirely ebracteate; calyx campanulate, tube scarious at least in the sinuses, 2.5 mm. long by 2.5 mm. wide at summit, lobes linear-lanceolate or -oblong, mostly acute, 3-3.5 mm. long, about $\frac{1}{2}$ length of corolla-tube; flowers solitary, lemon-yellow, corolla-tube 6 mm. long, lobes obovate, entire or erose; anthers apparently sessile, their attachment in upper $\frac{1}{4}$ of tube.

Type locality: "Habitat in alpinis Pyrenaeis & Italicis."

Range: Europe, in the Alps and Pyrenees Mountains, at an altitude of 5,000-9,000 feet.

EUROPE. Austrian Alps: Col di Rodella, Tirolia, 1901, *Sterneck* (G); Padon-pass north of Marmolada, 1899, *Prell* (US). French Alps: de Villars St. Christophe, Isere, 1898, *Bernard* (UC,US); Col de Chariere Versont de Maurienne, Savoie, 1863, *Delavay* (US); Col Assiette, Alpes Cottiennes, July, *Rostan & Beyer* (US); Col de Malrif, Dauphine, 1860, *Cosson* (G). Swiss Alps: Riffelhorn, Zermatt, 1885, *Lomax* (UC), 1884, *Baenitz* (UC,US); Simplon Pass, 1872, *Ball* (G); Gorum Grat, Zermatt, 1911, *Sull* (ANSP); Col de Glaize, 1860, *de Salon* (ANSP,US). French Pyrenees: Col d'Iture, Hautes-Pyrenees, 1881, *Bordere* (WSC); Pic du Midi, 1859, *Mill* (ANSP); Somaute, 1867, *Bordere* (G). Spanish Pyrenees: Castagnaise, Arragoni, 1839, *Mastres* (G); Spain, *Bonplan* (G).

Despite the unique color of the corolla of *D. Vitaliana*, all the characters of habit, pubescence and floral morphology indicate that it is a true congener of the other species of this genus.

4. DOUGLASIA MONTANA Gray, Proc. Amer. Acad. 7: 371. 1868.

Androsace uniflora Haussknecht, Mitt. Bot. Ver. Gesamt-Thüringen, 23. 1890. *Primula montana* Derganc; Kneucker, Allg. Bot. Zeitschr. 10: 111. 1904. *Douglasia*

montana vars. *typica* R. Knuth and *uniflora* R. Knuth, Pflanzenr. IV. 237: 169. 1905. *Gregoria montana* House, N. Y. State Museum Bull., nos. 233-234: 69. 1921.

Laxly to pulvinately caespitose, 2-10 cm. high, from a slender tap root; leaf-whorls becoming more or less remote or remaining confluent if the habit is strongly depressed, and the leaves reflexed, in age; peduncles, pedicels, involucre, calyces and sometimes the leaves, stellate-glabrate; leaves linear-subulate or -oblong, 4-8 mm. long by 1-2 mm. wide, broadest at base, entire or nearly so, glabrous save for the conspicuously and permanently ciliate margins; peduncles 1-several from a terminal rosette, 5-20 mm. high, bearing an involucre of 1-3 subulate bracts (when more than 1 flower is present), or simple and provided with 1 or 2 subulate bracts under the calyx of the solitary flower; flowers 1-3, rose-violet, pedicels 1-10 mm. long, equal to very unequal in length; calyx turbinate-campanulate, the tube 3 mm. high by 2.5-3 mm. broad at summit, lobes lanceolate or ovate-lanceolate, usually acute, 2-2.5 mm. long, exceeding or equalling (or surpassed by) the corolla-tube; corolla-tube 4-4.5 mm. long, lobes obovate, erose, 5 mm. long; filaments 0.5 mm. long, attached in upper 1/3 of tube.

Type: Rocky Mountains, Montana Territory, 1867, Winslow J. Howard (G: type, first specimen cited). This was probably collected near Helena.

Range: Rocky Mountains of northern Wyoming, southern and western Montana and adjacent Idaho, at 5,000-12,000 feet altitude; Canadian and Hudsonian Life Zones.

WYOMING. County undet.: Owl Creek Mts., 1873, Putnam (G). MONTANA. County undet.: "Rocky Mts. of Montana," Pearsall 908 (M,NY); "Plains near the N. Boundary of Montana," 1883, Canby 225 (ANSP); Bald Mt., 1880, Watson 263 (ANSP,G,US). Teton Co.: Mt. Henry, Midvale, 1903, Umbach 196 (MS,NY,US). Lewis & Clark Co.: Helena City, on the peaks, 1867, M. A. Brown (G,NY); Mt. Helena, 1883, Canby 146 (ANSP,WSC); Helena, 1883, Tweedy 828 (S). 1886, R. S. Williams 349 (G), 348 (MS,US), 1888, Kelsey 5298 (M,NY,UC), 1921, Wooton (NY,US); Birdtail Mts., 1887, F. W. Anderson (M,UC); Wolf Creek, 1930, E. J. Palmer 36,983 (G,M). Powell Co.: Deer Lodge, 1883, Brandegee 954 (ANSP,G), 1888, Traphager (NY); Mt. Goordon, 1930, Young 3 (MS). Meagher Co.: Hell Gate, 1860, Pearsall (NY); Cottonwood Creek, 1896, Flodman 716 (NY); Long Baldy, 1896, Flodman 717 (NY,US). Broadwater Co.: Belt Mts. near White's Gulch, 1882, Canby (ANSP,G,M); Belt Mts., 1883, Scribner 146 (ANSP). Jefferson Co.: Bernice, 1900, Blankinship (MS). Park Co.: 1889, Tweedy (G,NY,UC); Wilsall, 1921, Suksdorf 519 (WSC); Livingston, 1901, Scheuber 73 (NY,US); Porcupine Creek, 1902, Blankinship (RM). Gallatin Co.: Plains near Bozeman, 1883, Brandegee 953 (G,UC); Spanish Peaks, 1896, Flodman 718 (NY); Bridger Mts., 1897, Rydberg & Bessey 4684 (NY), 4685 (NY,US); Bozeman Pass, 1883, Scribner 146 (G); Bozeman, 1906, Blankinship 344a (RM,S,UC); Sedan, 1901, B. J. Jones (G,RM,S,US); Bridger Canyon, 1899, Blankinship (MS,TH,US,WSC), 1901, E. J. Moore (CAS,OSC); Bridger Mt., 1905, Blankinship 344 (ANSP,US). Madison Co.: Old Hollowtop, Pony, 1897, Rydberg & Bessey 4686 (ANSP,G,MS,NY,US), 1888, Tweedy 156 (NY,UC). Beaverhead Co.: Lima, 1895, Rydberg 2748 (NY); Dewey, 1902, Blankinship (MS). Deer Lodge Co.: Little Blackfoot Creek, 1883, Canby 225 (G,US); Garrison, 1899, Blankinship (MS). Missoula Co.: Missoula, 1915, Kittredge (G), 1921, Kirkwood 1244 (M), 1933, Hitchcock 1507 (CAS,MS, RM). IDAHO. Lemhi Co.: Mill Creek, Salmon River Mts., 1895, Henderson 4016 (US). Valley Co.: Gold Fork Lookout, Sawtooth Mts., 1937, Thompson 13,766 (UC).

This species varies greatly in habital characters, presumably in response

to diversity of habitat and altitude, so it is not surprising that various phases have been assigned specific, varietal or herbarium names. However, none of these segregates, save the following variety, appears to manifest dependability in morphological characters or any noticeable correlation with geographical distribution, so all are considered here to be phenotypic variants.

4a. *DOUGLASIA MONTANA* Gray var. *BIFLORA* (A. Nels.) R. Knuth, *Pflanzenr.* IV. 237: 169. 1905.

D. biflora A. Nelson, *Bull. Torrey Bot. Club* 25: 277. 1898.

Of the many characters drawn into service by the author of this segregate, only one, the strikingly unequal length of the pedicels whenever two flowers are present on a peduncle, seems to be reliable. When the second flower is suppressed, the bract or bracts are often situated well below the calyx and sometimes subtend abortive flowers. This condition of the inflorescence seems to be sporadic over the range of the species, but is predominantly uniform in the Wyoming specimens examined. Hence, although Rydberg considered *D. biflora* to be synonymous with *D. montana*, it seems wisest to retain the unit in varietal status, following Knuth.

WYOMING. Sheridan Co.: Head of T-(Tongue?) River, Big Horn Mts., 1859, *Hayden* (M); Wolf, 1912, *Cary* 732 (US); Willits Creek, 1909, *Willits* 549 (RM); Dome Lake, 1896, *A. Nelson* 2450 (RM: type, G.M.N.Y.: isotypes), 1897, *Pammel & Stanton* 98 (M.N.Y.); Big Horn Mts., 1899, *Twedy* 2581 (NY). Sheridan-Johnson cos.: Sheridan-Buffalo, 1900, *Twedy* 3480 (NY,RM,WSC). Johnson Co.: head of Powder River and along Big Horn Mts., 1859, *Hayden* (M); Clear Creek & Crazy Woman River, 1900, *Twedy* 3479 (NY,RM). Big Horn Co.: Medicine Mt., 1935, *Omney* 839 (RM); Bald Mt., 1936, *Williams & Williams* 3054 (NY). Sublette Co.: Fork of Green River, 1860, *Hayden* (M); Green River Lakes, 1925, *Payson & Payson* 4472 (RM: possibly this, but 2nd floret completely suppressed). Yellowstone Park: Nez Perces Creek, 1899, *Nelson & Nelson* 6203 (G.M.N.Y.RM.S.US). MONTANA. ? Park Co.: Wilsall, 1916, *Suksdorf* 153 (G,WSC: at least Gray specimen shows a typical inflorescence). Gallatin Co.: Spanish Basin, 1897, *Rydberg & Bessey* 4683 (MS,NY,RM.US), 4687 (G,NY). ? Broadwater Co.: Lone Mt., 1906, *Roadhouse & Chestnut* 11 (UC).

5. *Douglasia Gormanii* sp. nov.

Planta perennis, dense caespitosa, 2-4 cm. alta; folia imbricata densissime rosulata, lineari-oblancoolata, 4-10 mm. longa, 1-2 mm. lata, obtusa, integra, pilis stellatis tomentosa; scapi uniflori, solitarii, bracteati; calyx turbinatus, 5-angulatus, lobis ovato-triangularibus, acutis; corolla rosea, longitudine lobos calycis non superans, faucibus manifeste coarctatis, fornicibus brevibus instructis, tubo 3 mm. longo, lobis cuneato-obovatis, integris; antherae infra fauces corollae affixae; filamenta brevissima; capsula globosa; semina abortu 2, 2 mm. longa.

Pulvinate-caespitose, 2-4 cm. high, successively branched from a stout tap root; branches ascending or erect, bearing terminal floriferous rosettes of very closely imbricated leaves, these withering-persistent and thickly investing the branches; leaves narrowly oblanceolate, 4-10 mm. long by 1-2 mm. wide, entire, obtuse, permanently canescent on dorsal faces and margins with stellate, bifurcate or simple hairs; peduncles stellate-canescant, solitary from terminal

rosettes, with 1 or 2 small ovate-triangular bracts under the calyx, 1-flowered, 1-2 mm. long in flower, but elongating to 1-2 cm. in fruit; calyx turbinate, the tube scarious, 3 mm. long by 3.5-4 mm. wide at summit, lobes ovate-triangular, acute, just exceeding corolla-tube; flowers solitary, rose-pink, corolla-tube conspicuously constricted, 3 mm. long, lobes cuneate-obovate, entire; styles 2.25 mm. long, shorter than tube (in the few flowers examined); anthers oval, obtuse; filament 0.5 mm. long, inserted in upper 1/3 of tube; capsule semi-globose, exceeding calyx tube slightly; seeds mostly 2, dark brown, oval-orbicular, plano-convex, finely pitted, 2 mm. long.

Type: Dry slopes of Red Mountain near Fort Selkirk, Yukon River Valley, 63° N. Lat., 137° W. Long., Yukon Territory, Canada, 1899, Gorman 973 (NY: type; TH: isotype).

CANADA. Yukon Territory: Lake Kluane to Don Jek River, 1920 (in fruit). Müller (ANSP,US). ALASKA. St. Lawrence Island: Iviktook Lagoon, Bering Sea, 1931, Mason (UC: cited as *D. arctica* by Hultén, Svensk. Bot. Tidskr. 30: 528, 1936).

It is a pleasure to name the species in honor of its discoverer, the late Martin W. Gorman, long a resident of Portland, Oregon, and an enthusiastic mountain climber, collector and amateur naturalist.

The depressed habit, bracteate peduncles and solitary flowers of *D. Gormanii* suggest a close relationship to *D. montana* and *D. arctica*, while the leaves are almost identical with those of the latter species. Indeed, Dr. A. E. Porsild, Botanist of the National Museum of Canada and well known student of the flora of Yukon and Northwest territories, advises me that he is unable to distinguish more than one species in this region, wherein both *D. arctica* and *D. Gormanii* occur. However, if the kind of pubescence is of basic taxonomic value, as it seems to be elsewhere in the group, then I am obliged to consider this a distinct entity. *D. Gormanii* appears to me to be no more closely related to *D. arctica* than *D. arctica* is to *D. montana*, an affinity suggested by Gray. It is conceivable that more complete exploratory collecting will join the ranges of the three and tend to obliterate the morphological differences so as to necessitate their being resolved into a single complex species.

6. *DOUGLASIA ARCTICA* Hooker f., *Flora Bor. Amer.* 2: 120. 1838.

D. nivalis var. *glabra* Duby; DC., *Prodr.* 8: 47. 1844. *Gregoria arctica* House, N. Y. State Museum Bull., nos. 233-234: 69. 1921.

Depressed-caespitose, 2-5 cm. high, from a stout tap root; leaves closely imbricated, the whorls becoming remote in age; peduncles stellate-canescant; leaves narrowly oblanceolate, 4-8 mm. long by 1-2 mm. wide, obtuse, thin, entire, glabrous save for the regularly ciliolate margin; peduncles solitary from terminal rosettes, about 5-20 mm. long, 1-flowered, bracteate (always?); calyx campanulate-turbinate, tube 2 mm. long by 2.5 mm. wide at summit, the lobes lanceolate, mucronate, 2 mm. long, conspicuously shorter than corolla-tube; flowers solitary, rose-pink, corolla-tube 5-6 mm. long, lobes cuneate,

3 mm. long, erose; filaments about 0.5 mm. long, inserted in upper $\frac{1}{4}$ of tube; ovules 15-25, mature seeds not seen.

Type: Arctic seashore, between the mouths of the Mackenzie and Coppermine rivers, no date, *Richardson* (K: type).

ARCTIC BRITISH AMERICA: King Point, Lat. N. $69^{\circ} 6' 40''$, Long. W. $137^{\circ} 40'$, 1906, *Lindström* (NY); Arctic Coast, 1900, *Stringer* (NMC); Seacoast betw. mouth of Mackenzie River & Herschel Island, 1893, *Stringer* (G.NMC); Shingle Point, Yukon Territory, 1933, *Porsild 6730* (NMC,UC); Richardson Mts., 68° N., 136° W., 1933, *Porsild 6709* (NMC,UC).

This species greatly resembles *D. montana* in habit, pubescence and inflorescence, and *D. Gormanii* in habit, inflorescence and leaf-form. However, lacking an amplitude of material and any collection from the area separating the ranges of the three, it seems preferable to keep them as distinct species.

SPECIES EXCLUDED

Douglasia Johnstoni A. Nelson, Proc. Biol. Soc. Wash. 20: 37. 1907.
= *Androsace Chamaejasme* Willd.; Linnaeus Sp. Plant. 1: 799. 1797.

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Book Reviews

FORTSCHRITTE DER PALÄONTOLOGIE. Herausgegeben von O. H. Schindewolf. 1. Band, Bericht über die Jahre 1935 und 1936. Gebrüder Borntraeger, Berlin, 1937. viii + 374 pp., 2 figs. Paper bound, RM 29.60.

Recent years have witnessed the establishment of various biological journals devoted wholly or in part to presenting in form of reviews the progress made in a certain field or even in a whole science, e. g. botany or zoology. The present series does neither represent an older journal in a new dress nor has the field of paleontology ever enjoyed any of the benefits accruing from the continued publication of such a journal. Hence paleontologists will now be in a much better position to view the advances of their science more fully than was possible heretofore. This is due in large measure to attempts which have been made throughout the volume not to lose sight of the relations existing between paleontology and geology while giving full recognition to the biological aspects of the science.

The series might perhaps be regarded as precocious for it was to succeed the "Handbuch der Paläozoologie," a work conceived on a large scale and at present in course of preparation. Since the appearance of the latter is not imminent paleontologists and others interested in paleontology will undoubtedly be very materially assisted by the new journal.

The present volume is divided into three major parts of rather unequal size: A) General Paleontology (pp. 1-36), contributed by Karl Beurlen, includes chapters on textbooks, general phylogeny and the theory of descent, paleobiology, biostratonomy, biostratigraphy, methods. Of interest may be the suggestion made by Beurlen (p. 21) to substitute the term "paleocology" for the linguistically more correct but cumbersome "paleoecology." B) Paleozoology (pp. 37-344), comprises a large number of chapters by 21 contributors (some of whom wrote more than one) and of varying extent, mostly assigned to the treatment of the phyla of the animal kingdom (Protozoa-Hominidae) though chapters on faunas, trails and problematic fossils, and paleoneurology are also found here. Especially the latter (17 pp., 9 of which are bibliography) written by Tilly Edinger, stands out for several reasons. This author published in 1929 a monograph "Die fossilen Gehirne" which is here being brought up to date by extending the period treated back to that date. Notable also is her statement (p. 241) that although the possibility of fossilization of brain matter exists its actual occurrence has as yet not been demonstrated. In future volumes this chapter is to lose its identity and is to be incorporated into the general introduction to the vertebrates. It is obviously this part of the book that will find the greatest use by paleontologists. C) Paleobotany (pp. 345-374) by Walter Gothan, treats first of the various plant groups, reviews briefly the floras (paleophytic, mesophytic, cenophytic) and concludes with a discussion of miscellaneous topics (problematic fossils, Wegener's theory of continental drift, and methods). Paleobotanists would certainly appreciate a somewhat fuller treatment in the future.

As the editor asserts the bibliography is limited to contributions of real value which have permanently advanced the previously available knowledge. Thus it is possible to condense into a book of this size the actual progress made and yet present a clear account of it.

The cosmopolitan character of the work is not only shown by the material treated but in addition is well established by the cooperation of 9 foreign contributors. The editor and publisher are to be congratulated for having produced such an excellent book. It is hoped that its reception and wide use will ensure the continuation of this new series.—TH. JUST.

FUR-BEARING MAMMALS OF CALIFORNIA. Their natural history, systematic status, and relations to man. By Joseph Grinnell, Joseph S. Dixon, and Jean M. Linsdale. Univ. California Press, vol. 1, pp. xii + 375, figs. 138, pls. 7; vol. 2, pp. xiv + 377-777, figs. 139-345, pls. 8-13. August 16, 1937. 2 vols., cloth \$15.00.

Animal natural history, free from the tendency to read human motives and human ways of thought into the actions of the animals, free from the tendency to dramatize, and free from the influence of human prejudice, is," Doctor Grinnell states, "exceedingly difficult to write." That the "Fur-bearing Mammals of California" is exceedingly well written is very evident to anyone having even a slight acquaintance with the field it covers. The two volumes constitute an authoritative and comprehensive treatise in which the authors have brought together and presented in a masterful way a vast fund of highly important and valuable information. The labor connected with such a work as this is prodigious, for it has been the product of at least 25 years of scientific observation and study of the animals in their native haunts as well as of specimens in the Museum of Vertebrate Zoology, University of California, by members of its staff and supervised by an acknowledged master. References in the text and in the more than 160 titles in the bibliography appended to vol. 2 document every important statement made by the authors. It is also adequately illustrated with paintings by Allan Brooks, photographs, many by Dixon, maps, line drawings, and diagrams. The authors discuss many subjects that are of general interest: history of fur trapping in California; present day fur trapping in California; effects of fur mammals on human activities; effects of human activities on fur mammals; population trends in the fur bearers of California; and fur farming in California. The critical reader may wish that more data relating to the fur trade had been given for the interval between 1845 and 1920.

At the beginning of the account of each species or subspecies, there is given a concise and detailed statement in small type of the vernacular names, *general characters*, *description*, *variations*, *young*, *measurements*, *skulls*, *weights*, *type locality*, *critical comment*, *distribution area in California*, and *specimens examined from California*. The reference to the original description is given under *type locality*. The remainder of the discussion deals with as many phases of the life history as it was possible for the authors to observe or to obtain from other competent observers. These include habitat, habits, and recorded history of the animal within the state. Stomach contents and other feeding observations on the food are recorded, burrows and nests are described, and the economic relations are discussed. This general scheme of treatment is departed from in only one instance, namely in the case of the grizzly bears. Here the authors give rather brief technical descriptions abstracted from C. Hart Merriam's "Grizzly and big brown bears (*Ursus*)" and then go on to state that "to simplify the presentation of general information, we will henceforth consider the grizzly bears of California under one heading, as if there were known to be but one species. Locality will give probable ground for allocation, if the reader so chooses, under one or another of Merriam's names, using the accompanying map (fig. 19)—which is in large part hypothetical—as a guide."

Especially interesting are the pages dealing with the occurrences of the species within the state, including also the one introduced species, the Virginia opossum. These two volumes contain information that is of as much interest to the advanced student as to the layman who is in quest of a readable but scientifically accurate account of the animals in their natural habitats. The "Fur-bearing Mammals of California" is thus an informative and trustworthy publication for which we should feel deeply grateful to the authors.—REMINGTON KELLOGG.

MORPHOLOGY OF THE POCKET GOPHER, MAMMALIAN GENUS THOMOMYS. By John Eric Hill. Berkeley: University of California Publications in Zoology, volume 42, no. 2, pp. 81-172, 26 figs. in text. \$1.00. Aug. 25, 1937 (transmitted Dec. 3, 1935).

This paper adds strength to the growing voice which proclaims that comparative anatomy is still a fertile, and vital, field of investigation. It is a splendid example of

a type of phylogenetic study which draws upon details of the *entire* anatomy in establishing familial and generic relationships, instead of relying solely, as is more usual, upon some special points (e.g., in rodents, the zygomaseteric structure).

The nearest relatives of the pocket gophers (Geomyidae) were recognized long ago in the kangaroo rats and pocket mice (Heteromyidae). Now Hill, in reviewing the entire anatomy of these forms, shows that the characters possessed by the two groups in common, to the exclusion of other rodents, are far more numerous and "individually of greater importance" than the features in which they differ from one another. This finding leads him to the conclusion that affinities are best expressed by assigning sub-family ranking to the heteromyids in the family Geomyidae.

The relationships of the geomyids (in this broader sense) usually have been considered to be with sciurids (squirrels and their allies) because of the similarity in the zygomaseteric structure in the two groups. But the total number of characters common to sciurids and geomyids, and not shared by muroid rodents, is small; some of these characters are adaptive and could have been independently acquired, others are primitive characters which have been retained by both. Contrarily, the geomyids resemble the muroid rodents in more than twenty specific features, involving almost every anatomical system; many of them are specializations found in forms of very divergent habits. The anatomical evidence thus points decidedly more toward muroid than toward sciurid affinities for the geomyids; Hill concludes that the Geomyidae (which includes the heteromyids) should be given superfamily rank, along with the Muroidea (true rats and mice, and their allies), in the infra-order Myomorpha.

Of the general morphological conclusions reached in this study, those pertaining to mammals as a group, rather than to rodents only, have the wider interest. They touch upon such topics as the importance of topographical relations in determining homologies of muscles; the progressive reduction or transformation of muscle to bone through ligamentous stages; the shifting of origins and insertions of muscles from one part to another; migration of blood vessels; changes in position of nerves within a plexus.

Although a consideration of the "anatomical features that have evident and special adaptive significance" is stated to have been one of the five aims of this study, it is regrettable that no special treatment is accorded adaptations either in the text or in the concluding discussion.

For the non-specialist, only the last few pages, which summarize the morphological and phylogenetic conclusions, are "readable." The bulk of the paper, nearly 80 pages, for the most part in 8-point type, consists of a minutely detailed description of the anatomy of *Thomomys* (based chiefly on *T. bulbivorus*) covering the skeletal, muscular, nervous, digestive and respiratory, circulatory, and urogenital systems; comparisons are made with other rodents, including *Geomys*, *Cratogeomys*, *Citellus*, *Sciurus*, *Apodonta*, *Dipodomys*, *Neotoma* and *Rattus*. The research worker will welcome this study. And it would prove a useful reference work in any laboratory where either comparative or mammalian anatomy is being taught.—WILLIAM L. ENGELS.

CONCORD RIVER, Selections from the Journals of William Brewster. Edited by Smith O. Dexter. Foreword by Thomas Barbour. Harvard University Press, Cambridge, Mass., 1937, x + 259 pp. Frontispiece in color and 11 other plates, 2 in color, the rest in black and white including one etching. Price \$3.50.

To one who has known Brewster only as a scientific ornithologist the appearance of the present work and its predecessor, *October Farm*, comes as a surprise. Like *October Farm*, *Concord River* is a series of excerpts from Brewster's diaries now deposited in Harvard University. The earliest entry is April 8, 1879, the last March 12, 1918, the year preceding Brewster's death.

The book is a model of excellent and charming English prose, and the beauty of it all is that it is based on exact observation. Brewster was never content to use indefinite terms and say: about, probably, such and such. As far as it was humanly possible he gives the exact figures for the number of birds observed in different situations and the number of eggs per nest. The book is filled with detailed information about New England bird life. Nor does he stop there; but, as in the case of October Farm, he has many observations on the mammals and batrachians, some on turtles and snakes around Concord; and occasionally he mentions insects, including anopheline mosquitoes, as well as early spring butterflies. He was as familiar with the calls of the spring frogs as he was with the notes of birds. Fishes are the only form of life that he seems not to have been concerned with, all the more remarkable as he was a great canoeist and boatsman.

One is impressed with his great love of nature in all its manifestations. He describes incidents of violence among the birds, but calmly refrains from interfering with nature's laws. Perhaps the most interesting is the murder of a female Downy Woodpecker by a male. After the tragedy Brewster saved the skin and skull of the victim as evidence of what transpired. One who amassed a collection of birds and eggs such as Brewster's must have committed many "bird murders," as he himself admits in the account of a young Martin caught by a Pigeon Hawk. None the less, his sympathy was always for the victim. We only wish his example of *laissez faire* in nature were carried out today, and that there were less interference with wild life. One finishes the book with the wish that more excerpts from Brewster's diary had been made, and with the hope that more will be written about his observations of animal life about Concord.

The book is attractively prepared, and the illustrations by his friend, Frank W. Benson, add much to its beauty. In the book he describes taking photographs of some birds. It might have been interesting to include one or two with the other illustrations. On the inside cover pages are printed maps of the region about Concord and October Farm. The book is furnished with a rather complete index both as to the animals mentioned and the persons who visited him.—M. W. LYON, JR.

THE NATURAL HISTORY OF MAGPIES. By Jean M. Linsdale. Contribution from the University of California Museum of Vertebrate Zoology. Published by the Cooper Ornithological Club, Pacific Coast Avifauna Number 25, Berkeley, California, August 24, 1937, 234 pp., colored frontispiece of the Black-billed Magpie and the Yellow-billed Magpie, figs. 20, pls. 8. $7\frac{1}{4} \times 10\frac{3}{8}$ inches.

The author has produced an excellent book on an interesting bird. Practically everything of interest about the compact genus *Pica* (19 named forms are recognized, most of them subspecies of *Pica pica*) is discussed in it: taxonomy, geographic distribution, habitat relations, food and feeding, habits, migration, nesting territory and courtship, nests, eggs, incubation period, young, anatomical considerations (under which are included weight and body temperature), plumages and moulting, general habits, populations and longevity, relations to other animals (including their parasites), relations to man, a list of vernacular names in the languages of the countries where magpies occur. The painstaking care with which the author has written this monograph is illustrated by the extensive bibliography of 646 titles. He left no source of information unprobed.

The greater part of his comments is based upon his own personal observations, primarily on the Yellow-billed Magpie, and secondarily on the Black-billed Magpie, as known by him and as culled from the literature. Detailed distributional maps of the American Magpies, as well as the foreign species, are given. Plates 1 to 8 are devoted to the new-born birds, half-grown and adult birds in flight and at rest, all taken from excellent photographs. Figures 4 to 11 are hythergraphs to demonstrate the relation of climate to the area occupied.—M. W. LYON, JR.

ENTOMOLOGIE mit besonderer Berücksichtigung der Biologie, Oekologie und Gradationslehre der Insekten. Von Walter Speyer. Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, Band 43. Theodor Steinkopff, Dresden und Leipzig, 1937. xi + 194 pp. Paper bound, RM 13.00.

The series of which the present volume is the last one published aims to summarize the most important advances made in a certain field since 1914. It is therefore somewhat comparable in character to the well-known British "Recent Advances." In fact "Entomologie" can be readily compared to Prof. Imms' "Recent Advances in Entomology." Both books make no attempt at completeness but their authors select material in certain fields which they deem worthy of inclusion. Dr. Speyer for example omits or treats very briefly certain aspects of entomology which receive considerable attention elsewhere, e.g. genetics, embryology, etc. Thus more space is obtained for a fuller treatment of other phases of entomological research less apt to be reviewed regularly than those just mentioned.

The book is divided into 8 parts, some of which are subdivided into chapters. The parts are: 1) paleontology and phylogeny; 2) morphology, anatomy, and physiology; 3) life cycle of insects; 4) parasitism and symbiosis; 5) behavior under certain circumstances (production of sound, thanatosis etc.); 6) life cycle, mass changes and geographic distribution of insects under the influence of abiotic and biotic factors; 7) migrations; 8) economic importance of insects. Appended are a bibliography arranged according to the parts of the book and an index of scientific names.

In part 6 considerable space is devoted to what is now best called "gradalogy" (according to Martini) often also referred to as "epidimiology." But "epidemic" pertains to a disease and not to its agent, hence "gradalogy" is preferable. It concerns itself with "all phenomena beginning with an increase of individuals, surpassing the climax of overproduction, and terminating in a decrease."

On the whole the space and treatment allotted to various chapters is somewhat uneven. Those parts of the book dealing with the fields mentioned in its subtitle are obviously the best and may be profitably consulted.—TH. JUST.

STUDIES ON THE BIOLOGY OF THE CRAYFISH *CAMBARUS PROPINQUUS* GIRARD. By William Carl Van Deventer. University of Illinois Bulletin, Vol. XXXIV, No. 100. Illinois Biological Monographs, Vol. XV, No. 3, pp. 1-67, graphs 1-49, August 13, 1937. \$1.00.

Isolated studies of the various phases of the life history of crayfishes have appeared from time to time but no complete detailed study of the life cycle of a single species has been made hitherto. It has remained for Van Deventer to make this thorough study of the developmental cycle of a single species in a particular area.

The author, after noting the general distribution of the species, proceeded to study his material by direct observation in the field over a period of two years. His data on growth have been expressed statistically.

The study includes extensive data on: (1) general habitat and reactions of young and adults; (2) the relation of Form I and Form II types of copulatory organs in the males to the breeding cycle; (3) seasons of copulation and egg laying; (4) hatching, growth and moulting in the young while attached to the swimmerets of the female; (5) growth and moulting of adult males and females as related to different seasons; (6) length of the life span of adults.

This investigation lays an excellent ground-work for studies in experimental ecology and reproductive cycles of *Propinquus* and furnishes data which may well be incorporated in laboratory studies of the crayfish.—C. L. TURNER.

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